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Hughes et al.

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(54) **METHOD AND APPARATUS FOR PRODUCING PAINT**

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(73) Assignee: **MicroBlend Technologies, Inc.**, Gilbert, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/598,826**

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Related U.S. Application Data

(63) Continuation of application No. 13/328,719, filed on Dec. 16, 2011, now Pat. No. 8,936,390.

(51) **Int. Cl.**

B01F 15/02	(2006.01)
B01F 15/04	(2006.01)
B01F 13/10	(2006.01)
B08B 3/02	(2006.01)
B01F 3/08	(2006.01)
B01F 15/00	(2006.01)

(52) **U.S. Cl.**

CPC ***B01F 15/0416*** (2013.01); ***B01F 3/0803*** (2013.01); ***B01F 3/088*** (2013.01); ***B01F 13/1063*** (2013.01); ***B01F 15/00064*** (2013.01); ***B08B 3/02*** (2013.01); *B01F 15/00032* (2013.01); *B01F 2215/005* (2013.01)

(58) **Field of Classification Search**

CPC .. B08B 3/02; B01F 13/1063; B01F 15/00032
USPC 366/152.1, 152.2, 160.1, 160.2, 160.5, 366/162.1, 177.1, 181.6, 605; 222/94, 132, 222/168, 168.5, 135, 137, 144, 144.5; 141/144–146, 104; 700/239

See application file for complete search history.

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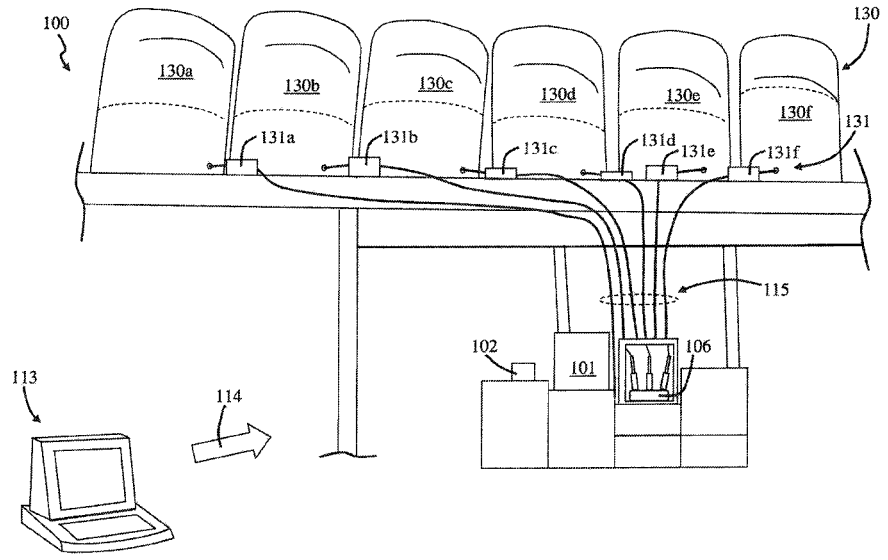
Primary Examiner — Charles Cooley

(74) *Attorney, Agent, or Firm* — Schmeiser, Olsen & Watts LLP

(57) **ABSTRACT**

The present invention is directed to a method and apparatus for producing an aqueous paint from a plurality of premixed compositions at the point of sale wherein the apparatus is cleaned during the paint production. The premixed compositions include a pigment composition, a dispersant-thickening agent composition, a high resin content binder, and a low resin content binder. The dispersant-thickening agent, when supplied in a cleaning amount, effectively cleans the nozzles and valves, used to supply the premixed compositions to a receiving reservoir for the desired aqueous paint.

13 Claims, 12 Drawing Sheets



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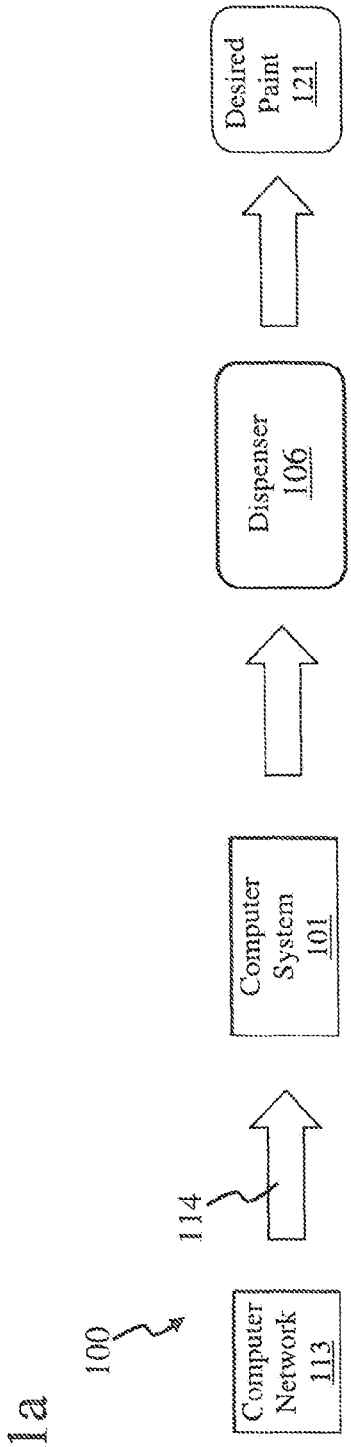

100
Computer Network 113
114
Computer System 101
Dispenser 106
Desired Paint 121

FIG. 1a

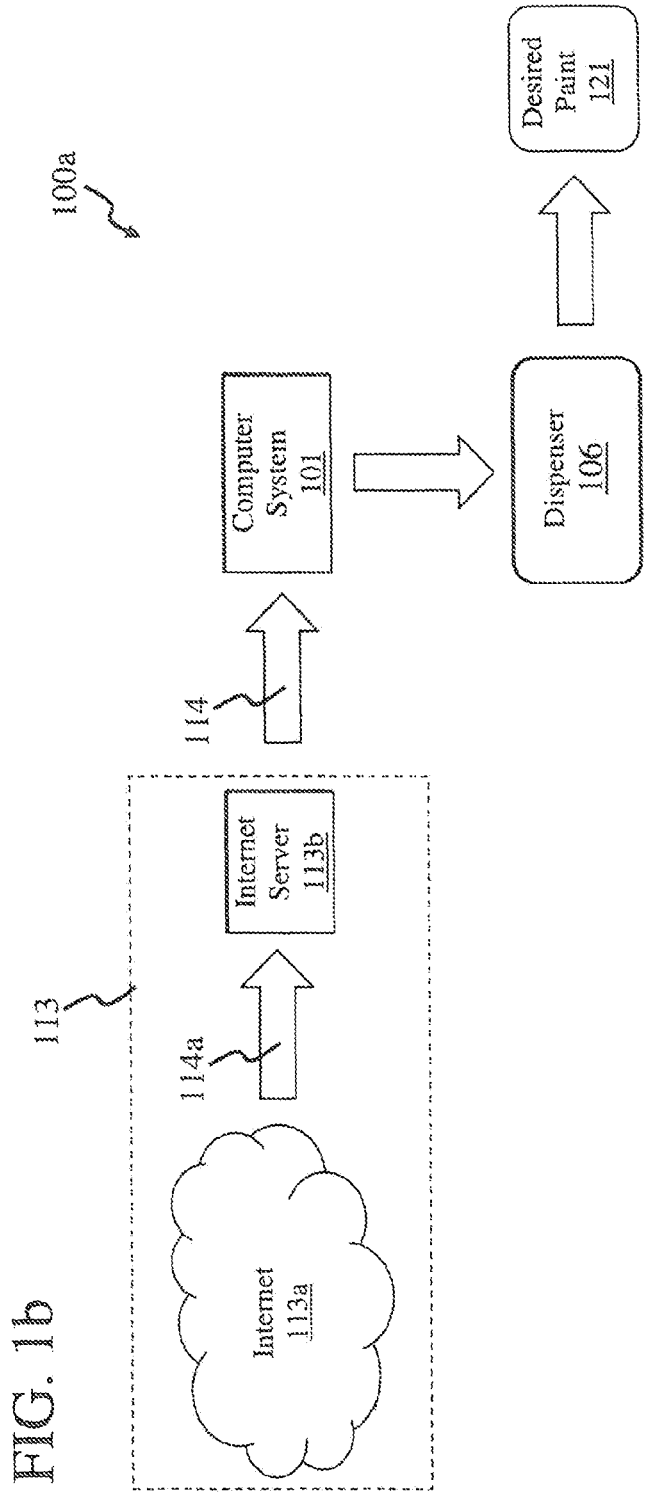

100a
Desired Paint 121
Dispenser 106
Computer System 101
114
113
114a
Internet Server 113b
Internet 113a

FIG. 1b

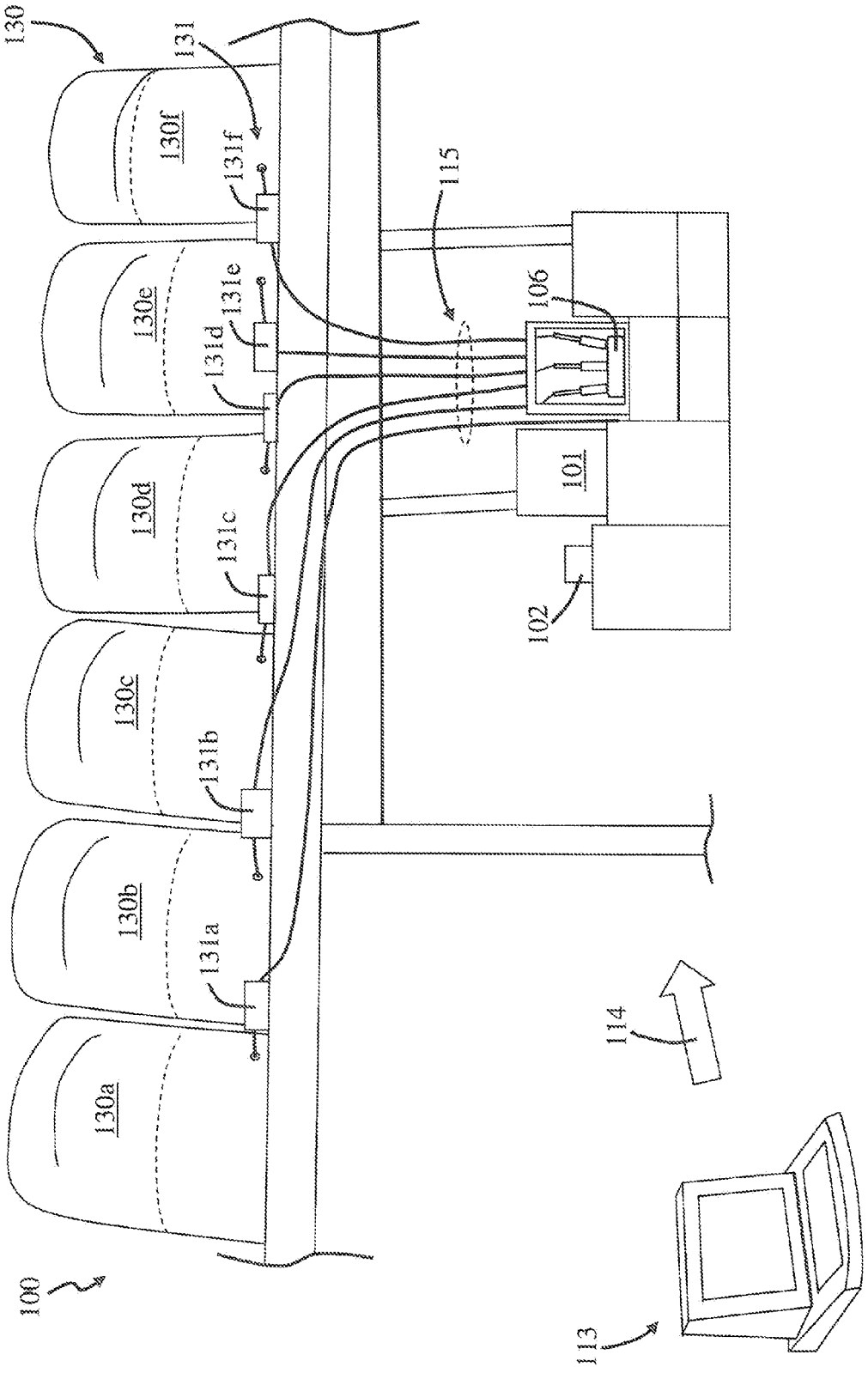

130
131
130f
131f
115
130e
131e
131d
106
130d
131c
101
102
130c
131b
130b
131a
114
130a
113
100

FIG. 2a

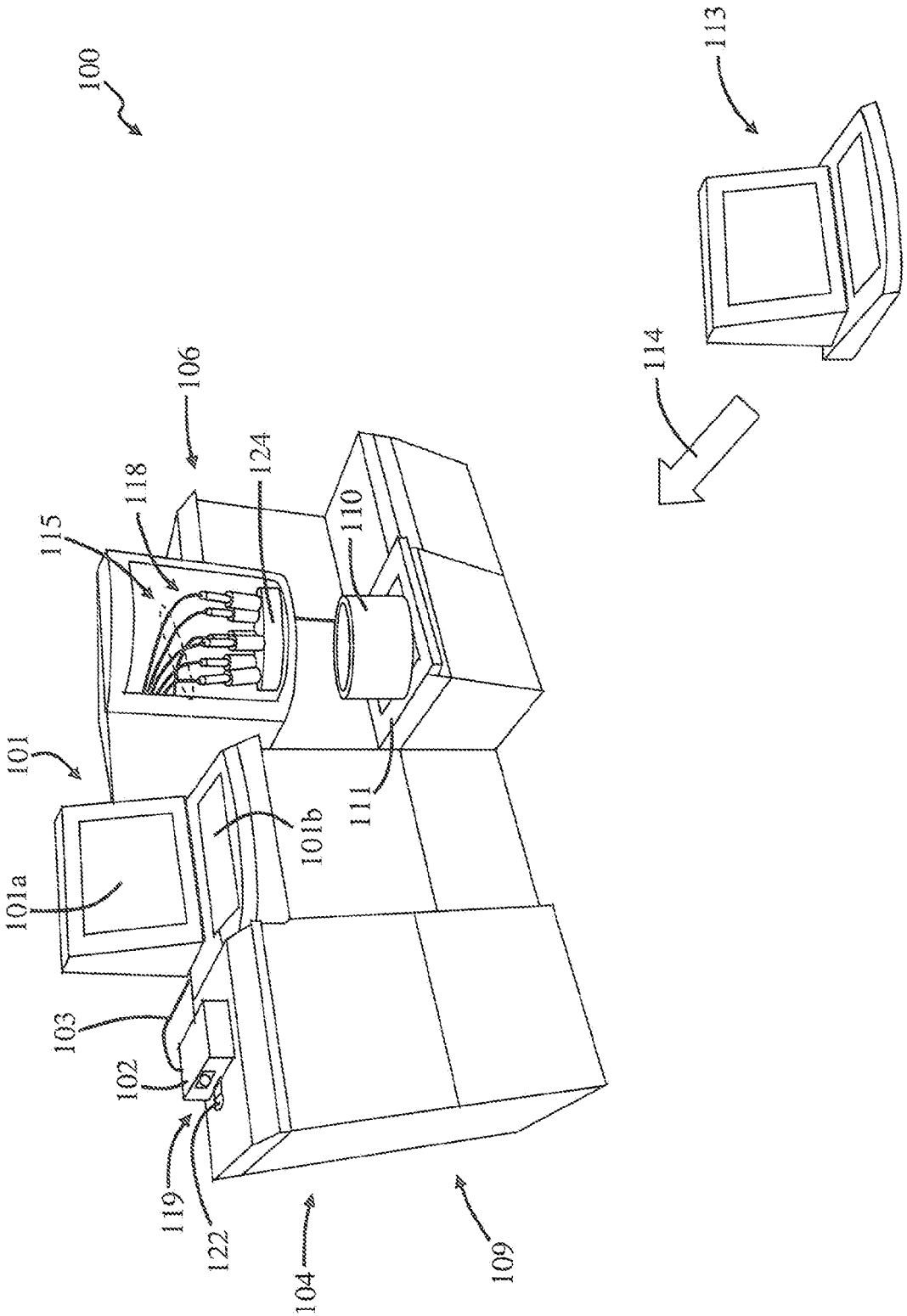
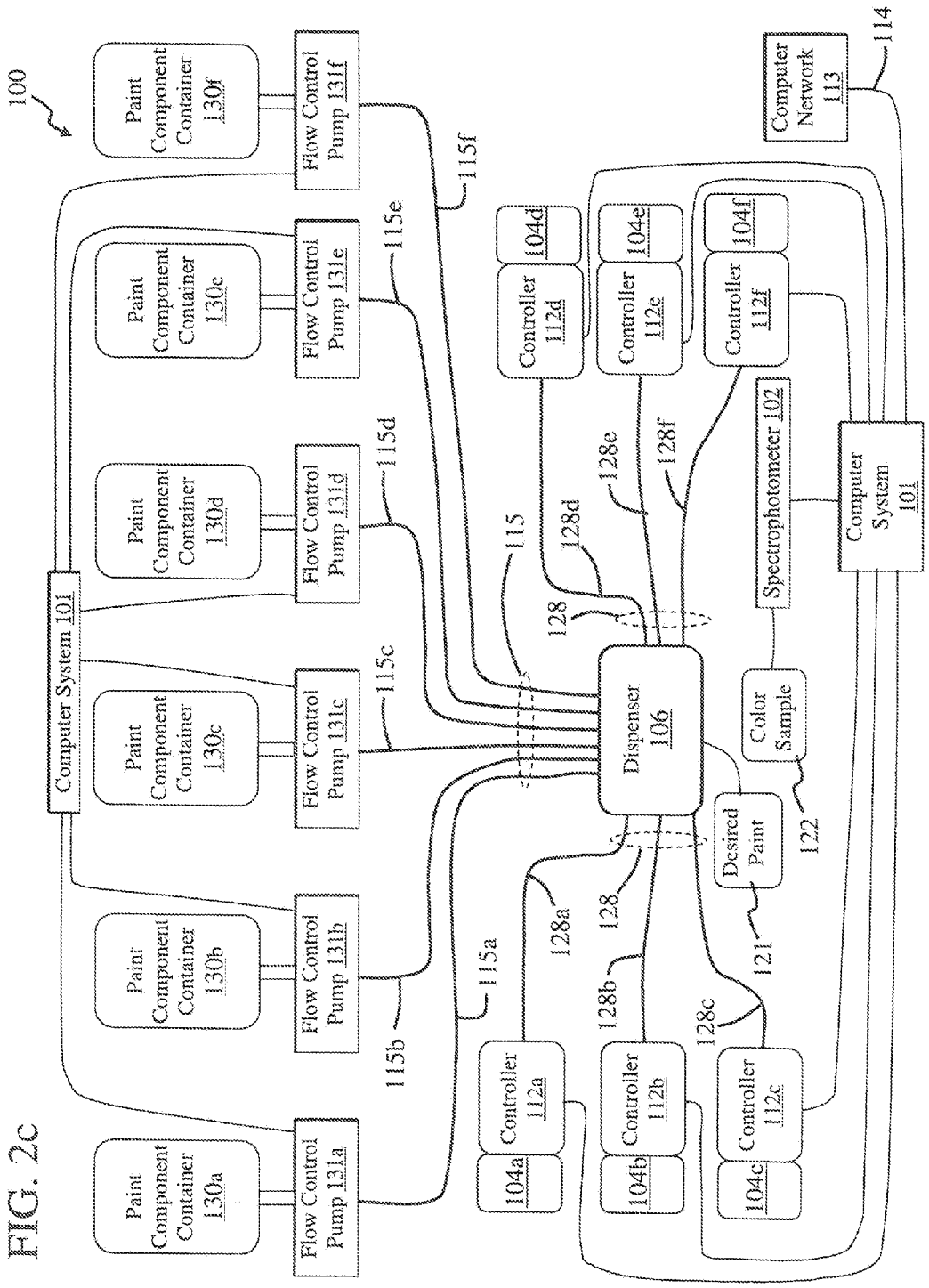

100
101
101a
101b
102
103
104
106
109
110
111
113
114
115
118
119
122
124

FIG. 2b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Computer System 101
Paint Component Container 130a
Paint Component Container 130b
Paint Component Container 130c
Paint Component Container 130d
Paint Component Container 130e
Paint Component Container 130f
Flow Control Pump 131a
Flow Control Pump 131b
Flow Control Pump 131c
Flow Control Pump 131d
Flow Control Pump 131e
Flow Control Pump 131f
115a
115b
115c
115d
115e
115f
115
Controller 112a
Controller 112b
Controller 112c
Controller 112d
Controller 112e
Controller 112f
104a
104b
104c
104d
104e
104f
128
128a
128b
128c
128d
128e
128f
Dispenser 106
Desired Paint
121
122
Color Sample
Spectrophotometer 102
Computer System 101
Computer Network 113
114

FIG. 2c

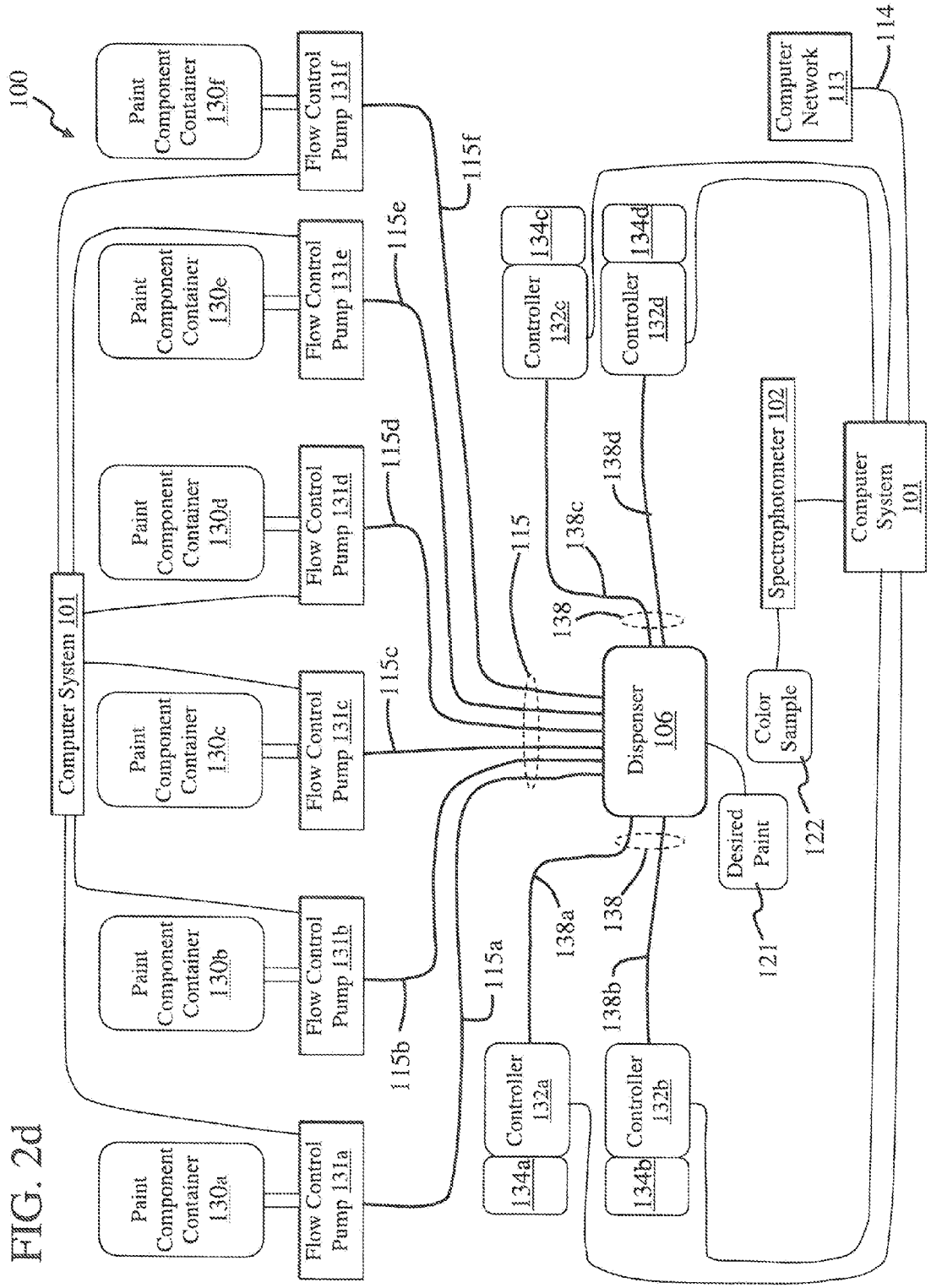

100
Computer System 101
Paint Component Container 130a
Paint Component Container 130b
Paint Component Container 130c
Paint Component Container 130d
Paint Component Container 130e
Paint Component Container 130f
Flow Control Pump 131a
Flow Control Pump 131b
Flow Control Pump 131c
Flow Control Pump 131d
Flow Control Pump 131e
Flow Control Pump 131f
115a
115b
115c
115d
115e
115f
115
Controller 132a
Controller 132b
Controller 132c
Controller 132d
134a
134b
134c
134d
138a
138b
138
138c
138d
Dispenser 106
Desired Paint
121
Color Sample
122
Spectrophotometer 102
Computer System 101
Computer Network 113
114

FIG. 2d

FIG. 3a

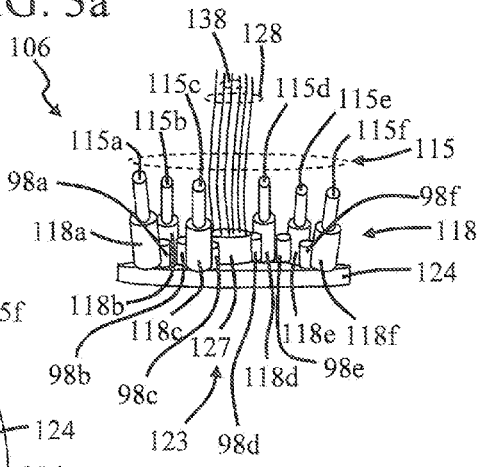


FIG. 3b

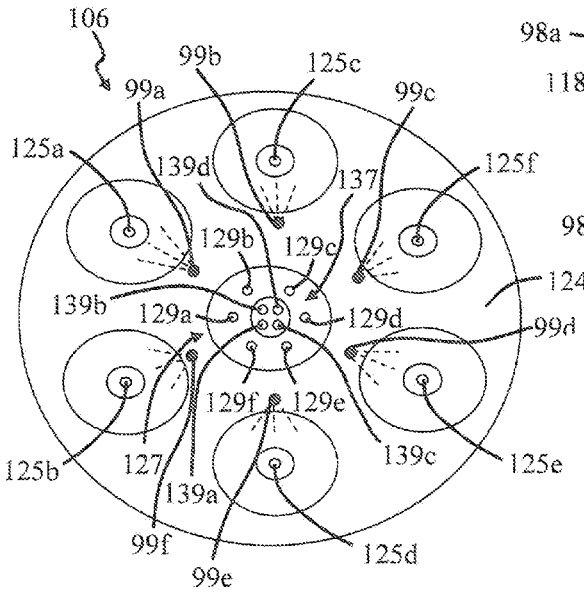


FIG. 3c

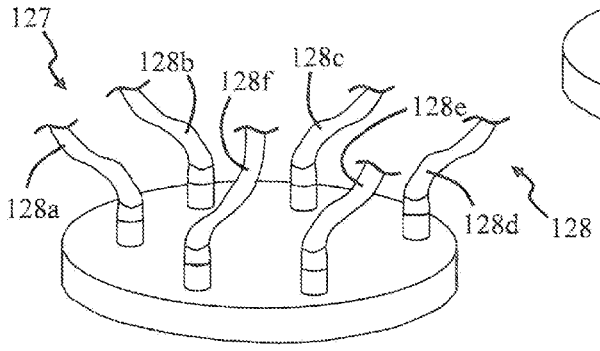


FIG. 3d

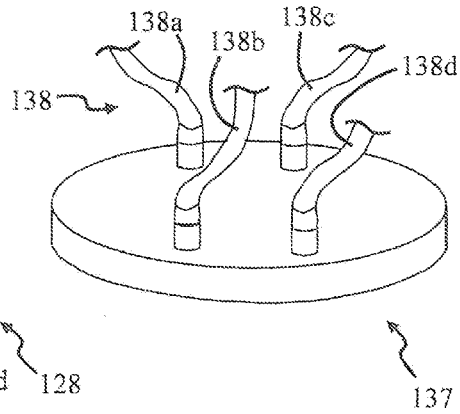


FIG. 4a

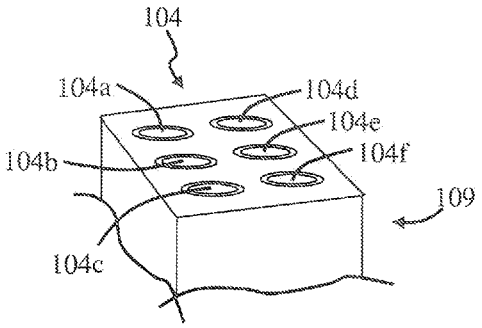


FIG. 4b

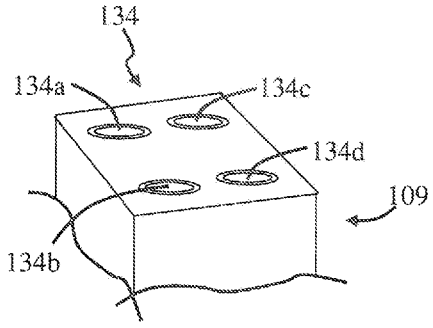


FIG. 4c

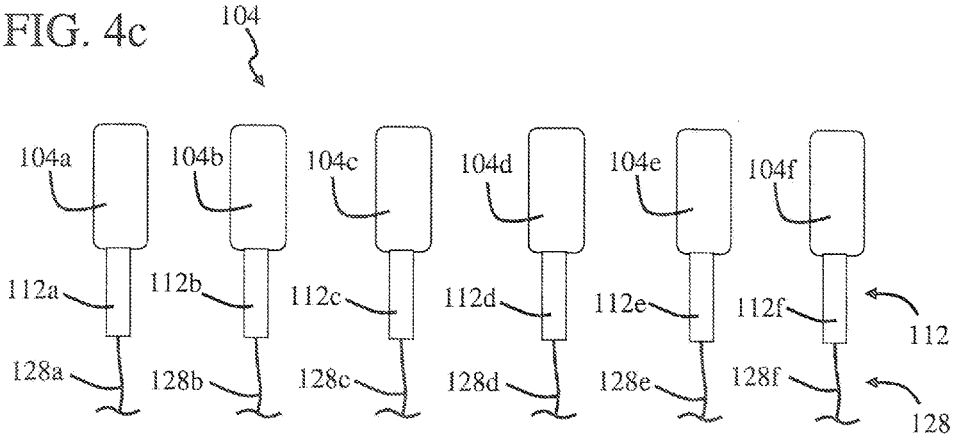


FIG. 4d

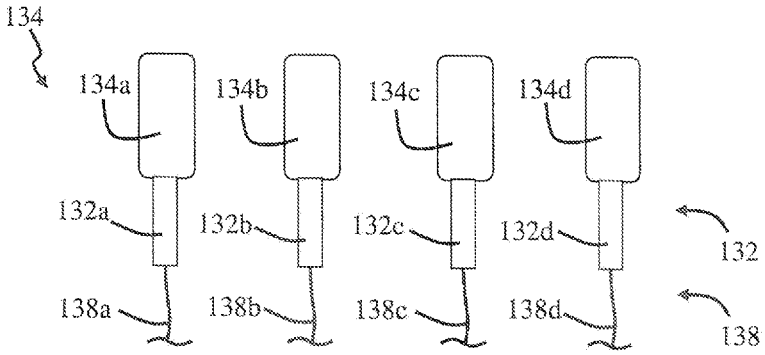


FIG. 5a

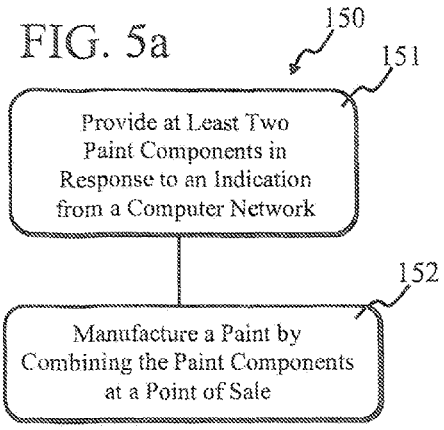


FIG. 5b

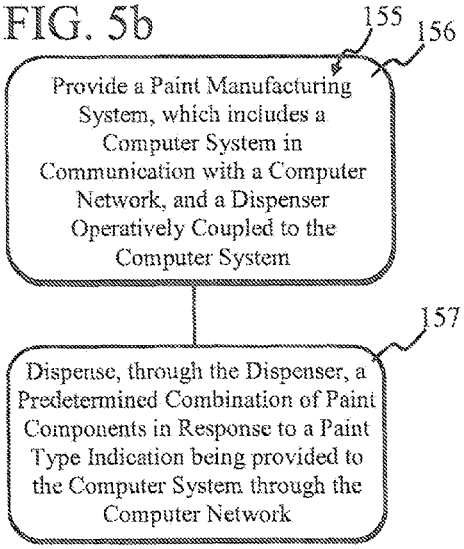


FIG. 5c

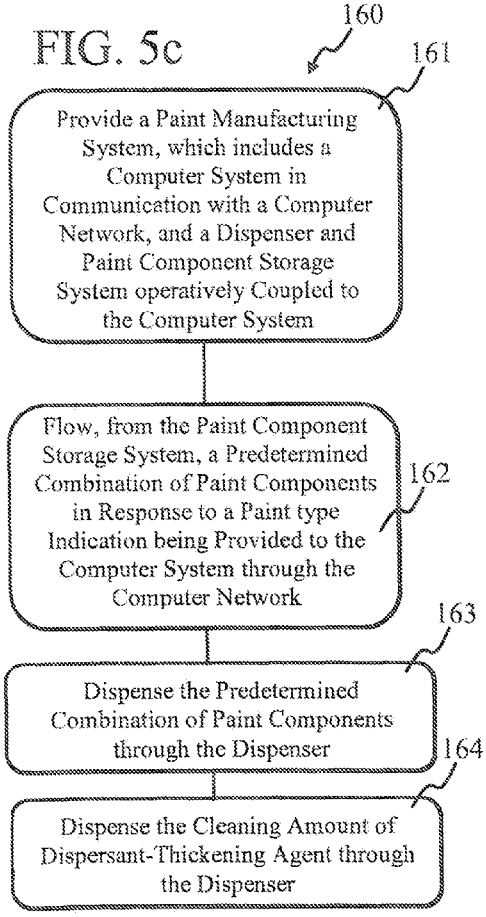


FIG. 5d

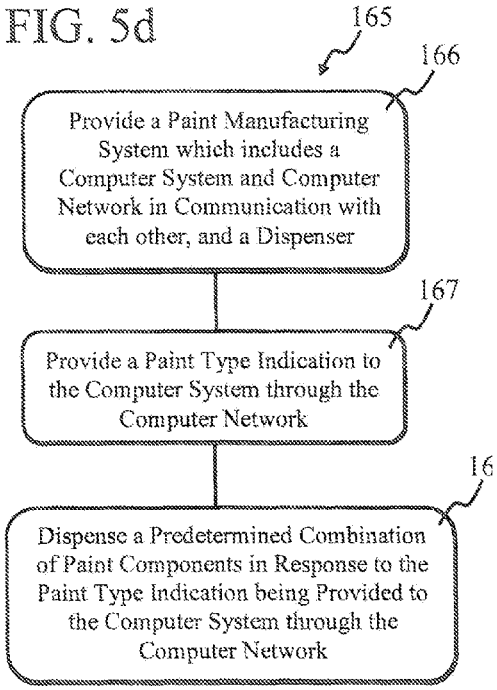


FIG. 5e

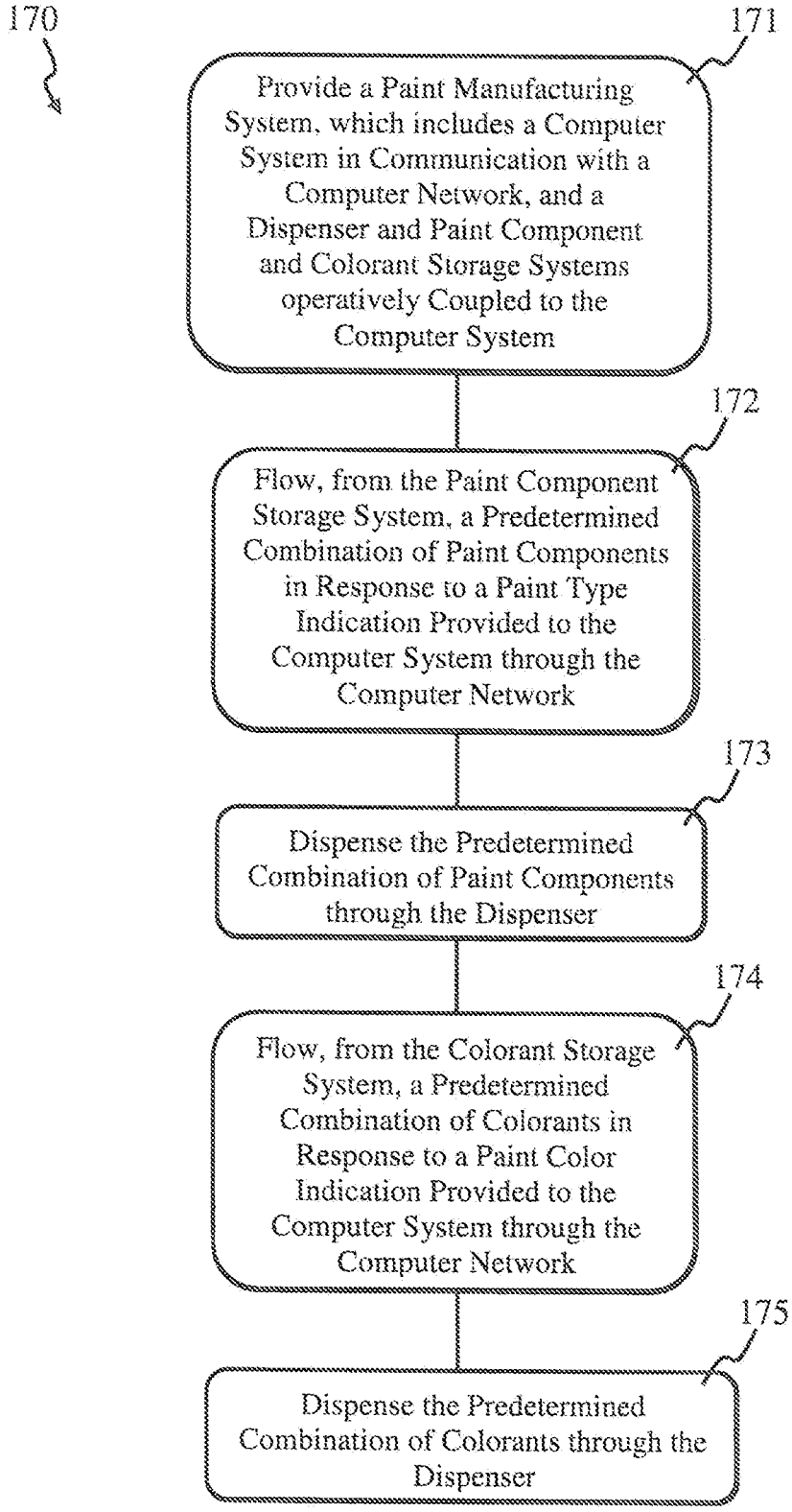

170
171
Provide a Paint Manufacturing System, which includes a Computer System in Communication with a Computer Network, and a Dispenser and Paint Component and Colorant Storage Systems operatively Coupled to the Computer System
172
Flow, from the Paint Component Storage System, a Predetermined Combination of Paint Components in Response to a Paint Type Indication Provided to the Computer System through the Computer Network
173
Dispense the Predetermined Combination of Paint Components through the Dispenser
174
Flow, from the Colorant Storage System, a Predetermined Combination of Colorants in Response to a Paint Color Indication Provided to the Computer System through the Computer Network
175
Dispense the Predetermined Combination of Colorants through the Dispenser

FIG. 6a

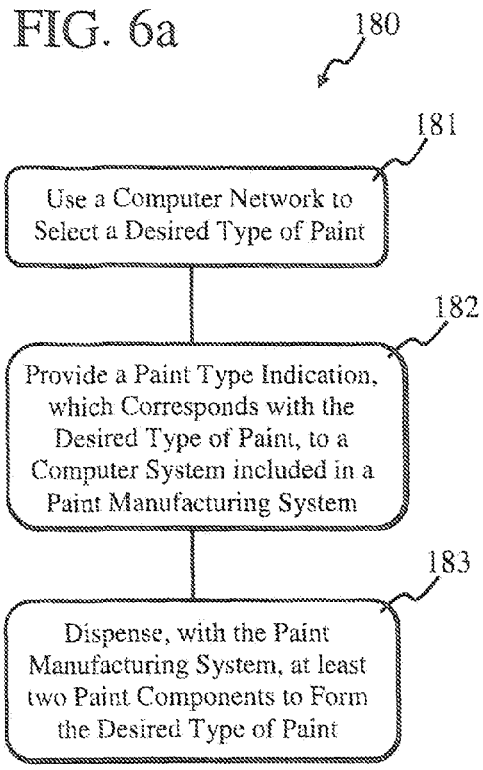

180
181
Use a Computer Network to Select a Desired Type of Paint
182
Provide a Paint Type Indication, which Corresponds with the Desired Type of Paint, to a Computer System included in a Paint Manufacturing System
183
Dispense, with the Paint Manufacturing System, at least two Paint Components to Form the Desired Type of Paint

FIG. 6b

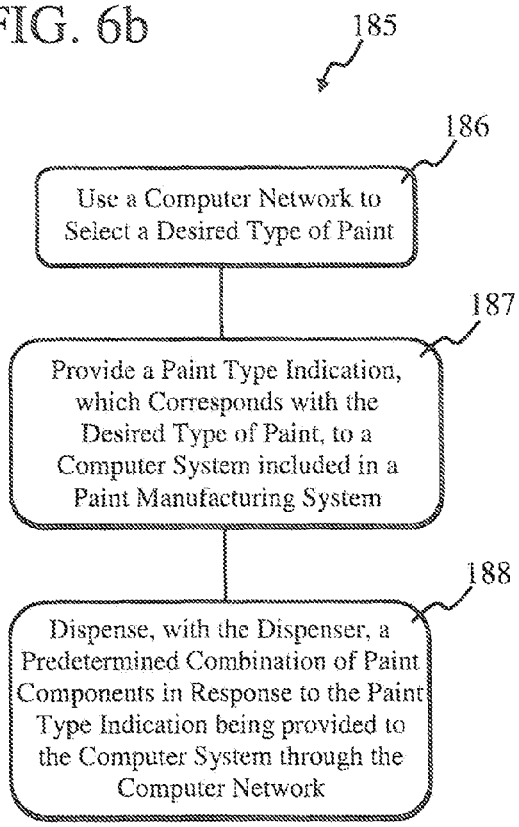

185
186
Use a Computer Network to Select a Desired Type of Paint
187
Provide a Paint Type Indication, which Corresponds with the Desired Type of Paint, to a Computer System included in a Paint Manufacturing System
188
Dispense, with the Dispenser, a Predetermined Combination of Paint Components in Response to the Paint Type Indication being provided to the Computer System through the Computer Network

FIG. 6c

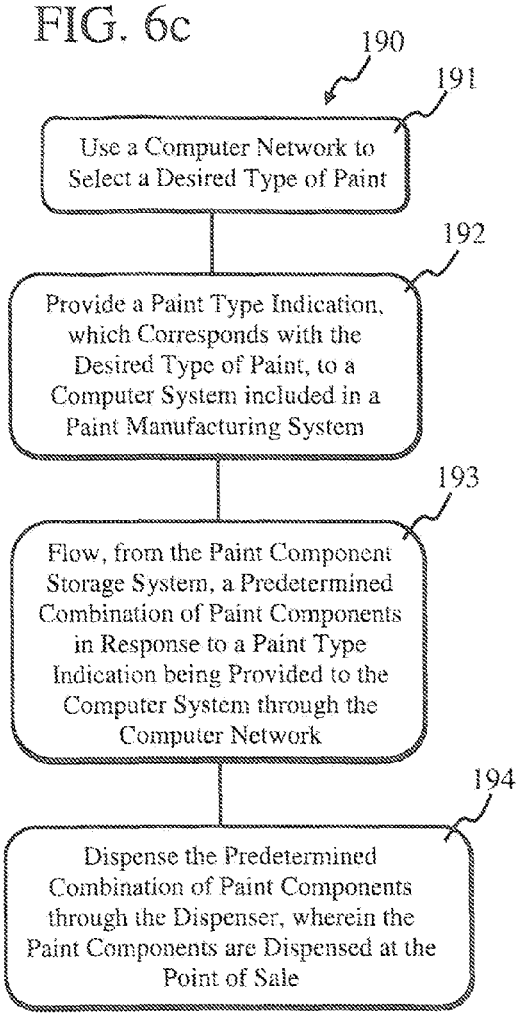

190
191
Use a Computer Network to Select a Desired Type of Paint
192
Provide a Paint Type Indication, which Corresponds with the Desired Type of Paint, to a Computer System included in a Paint Manufacturing System
193
Flow, from the Paint Component Storage System, a Predetermined Combination of Paint Components in Response to a Paint Type Indication being Provided to the Computer System through the Computer Network
194
Dispense the Predetermined Combination of Paint Components through the Dispenser, wherein the Paint Components are Dispensed at the Point of Sale

FIG. 6d

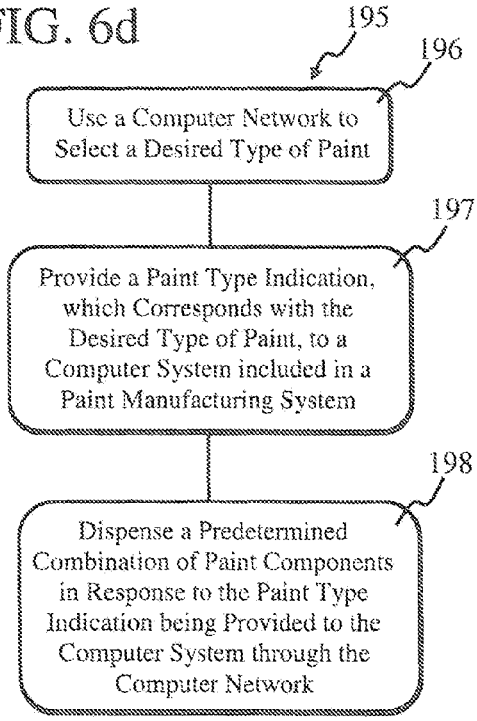
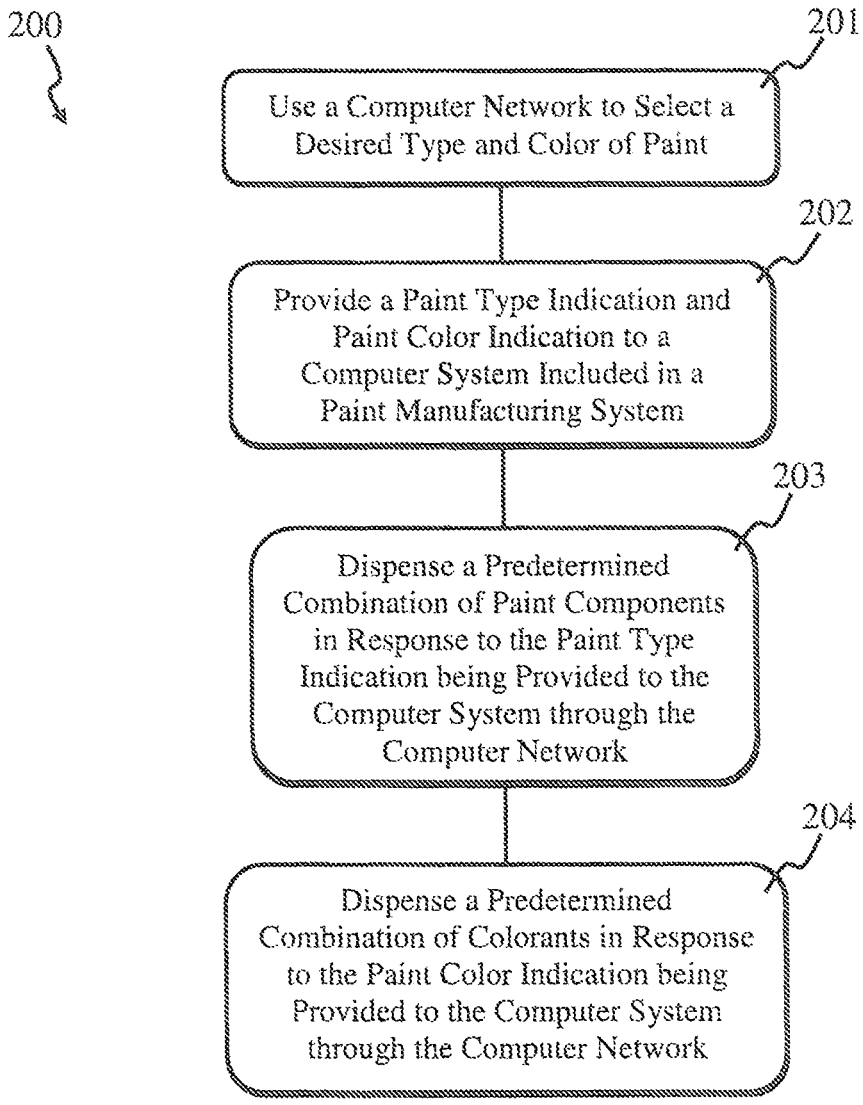

195
196
Use a Computer Network to Select a Desired Type of Paint
197
Provide a Paint Type Indication, which Corresponds with the Desired Type of Paint, to a Computer System included in a Paint Manufacturing System
198
Dispense a Predetermined Combination of Paint Components in Response to the Paint Type Indication being Provided to the Computer System through the Computer Network

FIG. 6e


200
201
Use a Computer Network to Select a Desired Type and Color of Paint
202
Provide a Paint Type Indication and Paint Color Indication to a Computer System Included in a Paint Manufacturing System
203
Dispense a Predetermined Combination of Paint Components in Response to the Paint Type Indication being Provided to the Computer System through the Computer Network
204
Dispense a Predetermined Combination of Colorants in Response to the Paint Color Indication being Provided to the Computer System through the Computer Network

METHOD AND APPARATUS FOR PRODUCING PAINT

This application is a continuation of U.S. patent application by MicroBlend Technologies, Inc. entitled "METHOD AND APPARATUS FOR PRODUCING PAINT", Ser. No. 13/328,719, filed Dec. 16, 2011, now U.S. Pat. No. 8,936,390 the disclosure of which is hereby incorporated herein entirely by reference.

BACKGROUND OF THE INVENTION

1. Technical Field

This invention relates to a method and apparatus for producing an aqueous paint from a plurality of premixed compositions wherein the apparatus is cleaned during the paint production.

2. Background Art

The traditional manufacture of paint has utilized processes which continuously fill containers with a neutral or base color at the central facility. The containers are transported to the point of sale and stored until resale. The transport and storage in the individual containers adds significantly to the cost of the sold product for it is necessary to inventory a wide variety of paints having different finish characteristics to satisfy consumer demand. For example, the finishes offered for sale range from the traditional flat paint through varying resin compositions up to a high gloss finish. Inventory is maintained for all the different finishes at the point of sale by the merchant.

The manufacture of paint at the central facility can be either a batch process or an extended continuous mixing process. The process typically calls for mixing a pigment containing ground titanium dioxide along with a thickener, a viscosity controlling agent and resin added to the water base. The pigment is a composition with a high percentage solids suspended in water. Storage for any significant period of time of a premixed pigment composition typically results in settling and a non-uniform distribution of constituents throughout the premix. Consequently, manufacturing processes are designed to limit the residence time in premixing containers in order to promote the manufacture of more uniform products.

Accordingly, there is a need for a method and apparatus for the production of an aqueous paint composition from a plurality of premixed compositions that reduces or eliminates the need to store multiple cans of paint. Further, there is a need for the efficient operation and cleaning of the apparatus at the point of sale.

DISCLOSURE OF INVENTION

The present invention is directed to a method and apparatus for the production of an aqueous paint composition of varying finish characteristics at the point of sale wherein the apparatus is cleaned during the production of the aqueous paint composition. This method eliminates the need for the merchant or a maintenance crew to disassemble certain parts of the apparatus for cleaning and allows the apparatus to function efficiently and without adding contaminants to the final aqueous paint composition.

The present invention provides a method for producing an aqueous paint composition comprising: selecting a paint composition recipe through a user interface, wherein the paint composition recipe comprises at least three different stable premixed aqueous compositions selected from the group consisting of a stable pigment composition, a stable dispersant-thickening agent composition, a stable high resin composition, and/or a stable low resin composition, wherein at least one of said three different stable premixed aqueous compositions is the dispersant-thickening agent; computationally determining a cleaning amount of the dispersant-thickening agent composition and subtracting the cleaning amount of the dispersant-thickening agent composition from a total amount of the dispersant-thickening agent composition to equal a dispensing amount of the dispersant thickening composition; dispensing the dispensing amount of the dispersant-thickening agent composition and the at least three different stable premixed aqueous compositions to a receiving reservoir; and then dispensing the cleaning amount of the dispersant-thickening agent composition to the receiving reservoir and agitating the receiving reservoir to produce the aqueous paint composition.

The foregoing and other features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1***a* is a block diagram of a paint manufacturing system, in accordance with the invention.

FIG. **1***b* is a block diagram of another embodiment of a paint manufacturing system, in accordance with the invention.

FIG. **2***a* is a perspective view of the paint manufacturing system of FIG. **1***a*.

FIG. **2***b* is a close-up perspective view of a portion of the paint manufacturing system of FIG. **2***a*.

FIG. **2***c* is a schematic diagram of the paint manufacturing system of FIG. **2***a*, showing a colorant storage system.

FIG. **2***d* is a schematic diagram of the paint manufacturing system of FIG. **2***a*, showing an additive storage system.

FIG. **3***a* is a perspective view of one embodiment of a dispenser, in accordance with the invention, included with the paint manufacturing system of FIG. **2***a*.

FIG. **3***b* is a bottom view of the dispenser of FIG. **3***a*.

FIG. **3***c* is a perspective view of a colorant nozzle included with the dispenser of FIG. **3***a*.

FIG. **3***d* is a perspective view of an additive nozzle included with the dispenser of FIG. **3***a*.

FIGS. **4***a* and **4***b* are perspective views of colorant and additive storage systems, respectively, in accordance with the invention, included with the paint manufacturing system of FIG. **2***a*.

FIGS. **4***c* and **4***d* are schematic diagrams of the colorant and additive storage systems of FIGS. **4***a* and **4***b*, respectively.

FIGS. **5***a*, **5***b*, **5***c*, **5***d* and **5***e* are block diagrams of a method, in accordance with the invention, of manufacturing a desired type of paint at a point of sale.

FIGS. **6***a*, **6***b*, **6***c*, **6***d* and **6***e* are block diagrams of a method, in accordance with the invention, of ordering a desired paint.

MODES FOR CARRYING OUT THE INVENTION

Four premixed aqueous compositions are sufficiently stable to be utilized at the point of sale to the user to generate a water-based paint composition having the desired finish characteristics. The four premixed aqueous compositions are mixed to develop paints ranging from a flat finish to a high gloss finish. However, all four of the aqueous compositions are not used to produce every paint composition.

The pigment-containing constituent or premixed pigment composition preferably contains titanium dioxide finely ground in an amount residing within the range of 40 to 50

percent by weight of the pigment. The ground titanium dioxide is a commercially available product used in a wide variety of paint compositions and its preparation techniques are well-known in the industry. The titanium dioxide is added to water which comprises about 25 percent of the resultant pigment composition. During the blending process, a mixture of calcined clay and silica in an amount of 15 percent by weight is added to maintain the titanium dioxide in suspension. A viscosity controlling agent is also added in an amount of about 10 percent of the resultant dispersion or pigment composition.

In order to maintain the titanium dioxide in a uniform dispersion, a dispersant-thickener is added during blending in an amount of less than 5 percent of the pigment composition. It has been found that the combination of a commercially-available dispersant supplemented by the addition of a phosphate-based dispersant such as potassium tri poly phosphate (KTPP) along with a modest amount of thickener enables the titanium dioxide pigment dispersion to remain uniform in distribution while stored.

The commercially available dispersant sold as Rhodaline 2861 (a federally registered trademark owned by Rhodia DSS) and manufactured by Rhodia DSS is the primary dispersant and is added in amount of about 3.6 weight percent. In addition, the phosphate based dispersant KTPP is added in an amount of about 0.2 weight percent to the pigment composition. It is believed that the phosphate ions in this additive replace the carbonate and other ions in the water to enhance the wetting properties of the water and thereby promote the distribution of the titanium dioxide throughout. The thickener added is a cellulosic thickening agent. Several are commercially available for use in the manufacture of aqueous paint compositions. One example is the thickener sold under the trademark 481 by AKZO NOBEL (Sweden).

The novel combination of these additives to the combination of titanium dioxide and water in the stated proportions has been found to enable the aqueous pigment composition to be used at point of sale to generate the wide scope of paint products. In tests of the pigment dispersion stored in a 55 gallon reservoir without agitation for a period of 2½ months, no discernible settling was noted. The addition of resin in an amount of about 5 percent of the dispersion has been found to aid in reducing the time for the resultant paint to cure. This factor is useful but tends to reduce the storage time of the pigment dispersion and is utilized only when a reduced curing time is important to the user.

At the point of sale, three additional premixed aqueous compositions are available to custom prepare the desired paint. The second composition in terms of likely usage is a dispersant-thickening agent which serves as a dilutant. The second composition is predominantly water in an amount of about 93 percent by weight. There are three additional additives to the second composition. They include a phosphate-based dispersant such as the potassium tri poly phosphate used in the pigment composition in an amount of less than 1 percent. The phosphate-based dispersant is added along with approximately a like amount of a thickener, such as cellulosic, HASE, HEUR and/or mixtures thereof. The combination of dispersant and thickener acts in the same manner as in the pigment composition although it is to be noted that the amount of thickener is several times that used in the pigment composition. The additional additive may be a coalescent, surfactant, defoamer, preservative and/or mixtures thereof in an amount of 4 to 5 weight percent. One commercial coalescent found suitable for use is sold under the federally registered trademark TEXANOL by Eastman Kodak Company.

The dispersant-thickening agent is preferably used in formulating all paint compositions with the exception of a high gloss finish paint composition. However, a small amount of dispersant-thickening agent may be used with high gloss finish paint compositions without any significant effects on paint quality. The dispersant thickening agent has also now been found to clean the nozzles and valves of the paint apparatus of the present invention.

The third and fourth compositions available for mixing are the resin-containing compositions. The low resin composition is preferably about 50 percent resin by weight and about 28 percent water. However, the percentage of resin by weight can be as low as 10 percent. To this mixture of resin and water is added diatomaceous earth as a flattening agent in the amount of about 7 percent and a combination of ground limestone, calcined clay, and/or other fillers. The combination of a dispersant and thickener are added in the aggregate amount of about 1.2 percent to promote the same long shelf life characteristic of the pigment composition.

The high resin component preferably contains resin in an amount of about 80 percent, water at about 15 percent and a commercially-available coalescent at about 2 percent. However, the percentage of resin by weight can be as high as about 90 percent. The amount of resin and water in the low and high resin compositions can be varied to achieve different finish characteristics. The resin utilized in the paint products formulated from the different combinations and found to provide the desired results is a 100 percent acrylic acrynol resin, such as the resin sold under the trademark 6629 by Arkema. However, it is to be noted that other commercially available resins can be used if desired.

The four above-discussed formulations have been determined to be stable and free from settling when stored in reservoirs for extended periods. To produce a desired paint product, each storage reservoir is coupled through fluid pumps and appropriate valves to dispensing outlets with the discharge therefrom preferably being directed into the receiving reservoir which is preferably the point of sale container or a portable paint container such as a paint bucket.

A flat finish product utilizes the dispersant thickening agent and low resin composition. To produce a higher quality flat paint and the paint products referred to as eggshell, satin and low sheen finishes a portion of high resin composition is added to the flat finish mixture. In the case of desired semi-gloss finish paint, the high resin component is used as a replacement for the low resin component. A full gloss paint utilizes the high resin component, but only a small amount of the dispersant thickening agent and no low resin composition. However, a small amount of dispersant-thickening agent may be used with full gloss paint without any significant effects on finish and/or paint quality.

The four compositions can also be varied to produce varying quality levels and to produce paint compositions that are suitable for either interior or exterior use and paint compositions having various color bases so that they are suitable for use as different types of colors. Therefore, it makes economic sense to have interior low resin and high resin compounds as well as exterior low resin and high resin components.

An interior paint composition will have less resin than a comparable exterior paint. Accordingly, interior paint compositions will have less of the high resin and/or low resin compositions than a comparable exterior paint composition. Quality is increased by decreasing the amount of dispersant thickening agent in a paint composition and increasing the amounts of the pigment composition and the low and high resin compositions. The amount of pigment composition is varied to change the type of color for which the paint com-

position is well-suited. Generally white base requires more pigment composition than pastels, pastels require more pigment composition than tinting, tinting requires more pigment composition than deep tone, and deep tone requires more pigment composition than neutral base. Typically neutral base paint compositions will not have any pigment composition.

The actual balances between the components for the different finishes can be varied in accordance with the needs of the purchaser for a particular type of finish. For example, a particular purchaser may require a paint composition that will have greater coverage. Also, color additives are added to vary the color of the paint after the four premixed aqueous compositions are added to form the basic paint composition.

Typical paint compositions suitable for programmed dispensing at the point of sale include the four aqueous compositions in the weight percentages shown below:

Finish	Pigment Comp.	Disp-Thickening	Low Resin	High Resin
Flat	33.7	0	34.7	31.6
Satin	36.4	17.9	9.6	39.3
Semi-Gloss	43.8	3.4	3.3	49.5
High-Gloss	44.5	0	0	55.5

All the foregoing examples are typical for retail quality paints suitable for interior and/or exterior use with pastel colors.

FIG. **1***a* is a block diagram of a paint manufacturing system **100**, in accordance with the invention. In this embodiment, paint manufacturing system **100** includes a computer system **101** in communication with a computer network **113**. Computer system **101** can be of many different types, such as a personal computer and laptop computer, and its operation will be discussed in more detail below. Computer network **113** can be of many different types, but it is generally a network of computer systems in communication with each other, as well as computer system **101**. Examples of a computer network include the Internet, a local area network and wide area network.

It should be noted that computer system **101** is generally positioned at a point of sale, and computer network **113** is generally not positioned at the point of sale. In some examples, however, a portion of computer network **113** is positioned at the point of sale and is included with paint manufacturing system **100**. For example, as discussed with FIG. **1***b*, computer network **113** can include an internet server that is positioned at the point of sale, wherein the internet server is included with paint manufacturing system **100**. An internet server is a computer system that allows other computer systems to access data files, programs, records and peripheral devices through a computer network. An internet server can also process requests for text and multimedia documents, such as hypertext mark-up language (HTML) documents, that are typically associated with a web page.

Computer system **101** and computer network **113** can be in communication with each other in many different ways. In this embodiment, computer system **101** and computer network **113** are in communication with each other through a communication link **114**, which allows the flow of signals between computer network **113** and computer system **101**. Communication link **114** can be of many different types, such as a wireless or wired communication link. An example of a wireless communication link is a wireless modem and an example of a wired communication link is an Ethernet cable. The signals can be of many different types, such as those corresponding to digital data.

In this embodiment, paint manufacturing system **100** includes a dispenser **106** which is operatively coupled to computer system **101**. More information regarding dispenser **106** is provided below with FIGS. **3***a*, **3***b*, **3***c* and **3***d*. In accordance with the invention, dispenser **106** dispenses a predetermined combination of paint components in response to a paint type indication being provided to computer system **101** through computer network **113** and communication link **114**. Dispenser **106** dispenses at least two paint components in response to the paint type indication being provided to computer system **101**. A desired paint **121** is formed in response to the paint components being dispensed by dispenser **106**. In this way, computer system **101** is operatively coupled to a dispenser.

Dispenser **106** can dispense the paint components in response to the paint type indication being provided to computer system **101** in many different ways. In one embodiment, computer system **101** is operatively coupled to a paint component storage system (not shown), which is in fluid communication with dispenser **106**. The paint component storage system flows the paint components to dispenser **106** in response to computer system **101** receiving the paint type indication through computer network **113** and communication link **114**. In this way, computer system **101** is operatively coupled to a dispenser through a paint component storage system, and paint components are dispensed by paint manufacturing system in response to a paint type indication. More information regarding one embodiment of a paint component storage system is provided below with FIGS. **2***a* and **2***c*.

In some embodiments, paint manufacturing system **100** includes a colorant storage system (not shown) operatively coupled to computer system **101**, wherein the colorant storage system is in fluid communication with dispenser **106**. More information regarding one embodiment of a colorant storage system is provided below with FIGS. **4***a* and **4***c*. The colorant storage system flows a predetermined combination of colorant(s) to dispenser **106** in response to a paint color indication being provided to computer system **101**. The paint color indication can be provided to computer system **101** in many different ways. In one embodiment, the paint color indication is provided to computer system **101** through computer network **113** and communication link **114**. In this way, computer system **101** is operatively coupled to a dispenser through a colorant storage system, and one or more colorant are dispensed by paint manufacturing system in response to a paint color indication.

In some embodiments, paint manufacturing system **100** includes an additive storage system (not shown) operatively coupled to computer system **101**, wherein the additive storage system is in fluid communication with dispenser **106**. More information regarding one embodiment of an additive storage system is provided below with FIGS. **4***b* and **4***d*. The additive storage system flows a predetermined combination of additive(s) to dispenser **106** in response to a paint additive indication being provided to computer system **101**. The paint additive indication can be provided to computer system **101** in many different ways. In one embodiment, the paint additive indication is provided to computer system **101** through computer network **113** and communication link **114**. In this way, computer system **101** is operatively coupled to a dispenser through an additive storage system, and one or more additives are dispensed by paint manufacturing system in response to a paint additive indication.

FIG. **1***b* is a block diagram of a paint manufacturing system **100***a*, in accordance with the invention. In this embodiment, paint manufacturing system **1** OOa includes computer system **101** and computer network **113** in communication with each

other through communication link **114**. As discussed above, computer system **101** is operatively coupled to dispenser **106**, which dispenses the desired type and color of paint, as well as an additive, if desired. In this embodiment, computer network **113** includes Internet **113***a* and an internet server **113***b* in communication with each other through a communication link **114***a*, wherein communication link **114***a* can be the same or similar to communication link **114**.

As mentioned above, computer system **101** is positioned at the point of sale. Further, in this embodiment, internet server **113***b* is also positioned at the point of sale. In this way, a portion of computer network **113** (i.e. internet server **113***b*) is positioned at the point of sale and another portion (i.e. Internet **113***a*) is not. It should be noted that, in some embodiments, internet server **113***b* is positioned so it is not at the point of sale. Further, in some embodiments, another portion of Internet **113***a*, other than internet server **113***b*, is positioned at the point of sale.

In operation, the consumer uses Internet **113***a* to access, through communication link **114***a*, a web page hosted by internet server **113***b* and selects the desired type and color of paint he or she desires, as well as any additives. When the paint is selected, internet server **113***b* provides this information to computer system **101** through communication link **114** and, in response, dispenser **106** dispenses the paint components and colorants, as well as the additives, to form desired paint **121**.

It should be noted that the consumer can pay for desired paint **121** in many different ways. For example, the consumer can pay for desired paint **121** using Internet **113***a* to access, through communication link **114***a*, the web page hosted by internet server **113***b*. The consumer can also pay for desired paint **121** when he or she goes to the point of sale to pick it up. The consumer can pay for desired paint **121** after it is shipped to a desired location, such as his or her home or place of business.

In some situations, the consumer pays for desired paint **121** before its paint components are dispensed by dispenser **106** and, in other situations, the consumer pays for desired paint **121** after its paint components are dispensed by dispenser **106**. In some situations, the consumer pays for desired paint **121** before its colorant(s) are dispensed by dispenser **106** and, in other situations, the consumer pays for desired paint **121** after its colorant(s) are dispensed by dispenser **106**. In some situations, the consumer pays for desired paint **121** before its additive(s) are dispensed by dispenser **106** and, in other situations, the consumer pays for desired paint **121** after its additive(s) are dispensed by dispenser **106**.

FIG. **2***a* is a perspective view of paint manufacturing system **100**, in accordance with the invention, and FIG. **2***b* is a close-up perspective view of paint manufacturing system **100**. FIGS. **2***c* and **2***d* are schematic diagrams of paint manufacturing system **100** showing a colorant storage system **104** and additive storage system **134**, respectively. In this embodiment, paint manufacturing system **100** includes computer system **101** in communication with computer network **113** through communication link **114**, as described above. Computer system **101** includes a monitor **101***a* and an input device **101***b*, wherein monitor **101***a* is embodied as a touch-screen monitor and input device **101***b* is embodied as a keyboard. Computer system **101** operates software that allows it to communicate with computer network **114** and allows it to control the operation of several paint manufacturing system components, such as a paint component storage system **130** (FIG. **2***a*), colorant storage system **104** (FIG. **2***c*) and additive storage system **134** (FIG. **2***d*). Paint component storage system **130**, colorant storage system **104** and additive storage system **134** can be positioned at many different locations, but, in this embodiment, they are positioned at the point of sale. In this way, paint manufacturing system **100** is capable of providing the desired type and color of paint, as well as any additives, at the point of sale.

As mentioned above, the paint components, colorant(s) and/or additive(s) are predetermined in response to one or more indications provided to computer system **101**. In some situations, the indications are provided to computer system **101** through monitor **101***a* and/or input device **101***b*. However, in accordance with the invention, the indications are provided to computer system **101** through computer network **113** and communication link **114**. More information regarding the flow of information between computer system **101** and computer network **113** is provided above with FIGS. **1***a* and **1***b*.

As mentioned above, paint manufacturing system **100** includes dispenser **106**, wherein the material dispensed by dispenser **106** is controlled by computer system **101**, as will be discussed in more detail below. Dispenser **106** dispenses materials which form desired paint **121** and provide it with the desired color and additives.

In this embodiment, and as shown in FIG. **2***b*, dispenser **106** includes paint component nozzles **118** supported by a nozzle support structure **124**. Nozzles **118** are connected to paint component storage system **130** through a paint component plumbing system **115**, and dispense pre-selected paint components in response to an indication from computer system **101**. Nozzles **118** dispense pre-selected paint components in response to the paint type indication being provided to computer system **101**.

In this embodiment, paint component storage system **130** includes paint component storage containers **130***a*, **130***b*, **130***c*, **130***d*, **130***e* and **130***f* (FIG. **2***a*). It should be noted that six paint component containers are shown in this embodiment, but there are generally two or more. The number of paint component storage containers corresponds to the number of paint components system **100** is capable of providing. In one particular example, containers **130***a*, **130***b*, **130***c* and **130***d* each contain the pigment composition, dispersant thickening agent, high resin content binder and low resin content binder, respectively. In this way, each paint component storage container contains a material which consists essentially of a paint component. Further, in general, each paint component storage container of system **130** contains a material which consists essentially of a single type of paint component.

In this embodiment, paint component storage system **130** is in fluid communication with plumbing system **115** through a paint component mass flow controller system **131**. Mass flow controller system **131** includes paint component mass flow controllers **131***a*, **131***b*, **131***c*, **131***d*, **131***e* and **131***f*. As shown in FIG. **2***c*, paint component containers **130***a*, **130***b*, **130***c*, **130***d*, **130***e* and **130***f* are in fluid communication with paint component hoses **115***a*, **115***b*, **115***c*, **115***d*, **115***e* and **115***f*, respectively, through mass flow controllers **131***a*, **131***b*, **131***c*, **131***d*, **131***e* and **131***f*, respectively. As shown in FIG. **2***c*, plumbing system **115** includes hoses **115***a*, **115***b*, **115***c*, **115***d*, **115***e* and **115***f* which allow paint components to flow between paint component storage system **130** and paint component nozzles **118** in response to the paint type indication being provided to computer system **101**.

Computer system **101** controls the operation of mass flow controllers **131***a*-**131***f* to control the amount of paint components which are allowed to flow through hoses **115***a*-**115***f*, respectively. The operation of mass flow controllers **131***a*-**131***f* can be controlled by computer system **101** in many

different ways, such as by providing the paint type indication to system **101** through monitor **101***a* and/or input device **101***b*. In accordance with the invention, however, the operation of mass flow controllers **131***a*-**131***f* is controlled by computer system **101** in response to the paint type indication being received by computer system **101** through computer network **113** and communication link **114**. In this way, computer system **101** is operatively coupled to dispenser **106** through a paint component storage system, and paint components are dispensed by dispenser **106** in response to a paint type indication.

The paint components are dispensed through paint component nozzles **118** and into a paint container **110**. Paint container **110** can be of many different types, such as a paint bucket, which allows the paint to be contained and carried away from the point of sale. In this embodiment, paint container **110** is supported on a paint weight scale **111**, which determines the weight of paint container **110** combined with the weight of the material, such as the paint components, colorants and/or additives, dispensed through dispenser **106**. Scale **111** can be of many different types, such as the PANTHER and PANTHER PLUS weighing terminals made by Mettler Toledo of Toledo, Ohio.

FIG. **3***a* is a perspective view of one embodiment of dispenser **106**, in accordance with the invention, and FIG. **3***b* is a bottom view of dispenser **106** looking in a direction **123** of FIG. **3***a*. In this embodiment, paint component nozzles **118** includes six paint component nozzles, denoted as nozzles **118***a*, **118***b*, **118***c*, **118***d*, **118***e* and **118***f* and pumps **98***a*, **98***b*, **98***c*, **98***d*, **98***e* and **98***f*. Pumps **98***a*, **98***b*, **98***c*, **98***d*, **98***e* and **98***f* are supported by nozzle support structure **124** and are in fluid communication with paint component storage system **130** through hoses **115***a*, **115***b*, **115***c*, **115***d*, **115***e* or **115***f*, respectively, of plumbing system **115** depending on which paint component container **130***a*, **130***b*, **130***c*, **130***d*, **130***e* or **130***f*, contains the dispersant-thickening agent component. Nozzles **118***a*, **118***b*, **118***c*, **118***d*, **118***e* and **118***f* are also supported by nozzle support structure **124** and are in fluid communication with paint component storage system **130** through hoses **115***a*, **115***b*, **115***c*, **115***d*, **115***e* and **115***f*, respectively, of plumbing system **115**. In this way, nozzles **118***a*, **118***b*, **118***c*, **118***d*, **118***e* and **118***f* are in fluid communication with paint component containers **130***a*, **130***b*, **130***c*, **130***d*, **130***e* and **130***f*, respectively. It should be noted that hoses **115***a*-**115***f* terminate at paint component openings **125***a*, **125***b*, **125***c*, **125***d*, **125***e* and **125***f*, respectively, as shown in FIG. **3***b*. Openings **125***a*-**125***f* extend through a bottom surface of nozzle support structure **124** so that the respective paint components are outputted through them and into paint container **110**.

Cleaning squirt nozzles **99***a*, **99***b*, **99***c*, **99***d*, **99***e* and **99***f* are also supported by nozzle support structure **124** and are in fluid communication with paint component storage system **130** through hoses **115***a*, **115***b*, **115***c*, **115***d*, **115***e* or **115***f*, respectively, of plumbing system **115** depending on which paint component container **130***a*, **130***b*, **130***c*, **130***d*, **130***e* or **130***f*, contains the dispersant-thickening agent component. In this way, nozzles **99***a*, **99***b*, **99***c*, **99***d*, **99***e* and **99***f* are in fluid communication with paint component containers **130***a*, **130***b*, **130***c*, **130***d*, **130***e* or **130***f*, depending on which paint component container contains the dispersant-thickening agent component.

In this embodiment, dispenser **106** includes a colorant nozzle **127**, as shown in a perspective view in FIG. **3***c*, carried by nozzle support structure **124**. Colorant nozzle **127** is connected to colorant storage system **104** through a colorant plumbing system **128** (FIG. **3***a*). Plumbing system **128** allows colorant components to flow between colorant storage system **104** and colorant nozzle **127**. Plumbing system **128** includes six colorant hoses, denoted as hoses **128***a*, **128***b*, **128***c*, **128***d*, **128***e* and **128***f*, which extend through nozzle **127** and terminate at colorant openings **129***a*, **129***b*, **129***c*, **129***d*, **129***e* and **129***f*, respectively, as shown in FIG. **3***b*. It should be noted that the number of hoses in plumbing system **128** typically corresponds to the number of colorants included in colorant storage system **104**. The colorant components are dispensed through openings **129***a*-**129***f* and into paint container **110** wherein they are combined with the paint components. As will be discussed in more detail below with FIGS. **4***a* and **4***c*, the flow of colorants through plumbing system **128** is controlled by computer system **101**. In particular, the colorants are flowed through plumbing system **128** in response to the paint color indication being provided to computer system **101**. In this way, computer system **101** is operatively coupled to dispenser **106** through a colorant storage system.

In this embodiment, dispenser **106** includes an additive nozzle **137**, as shown in a perspective view in FIG. **3***d*, carried by nozzle support structure **124**. It should be noted that additive nozzle **137** is shown as extending through colorant nozzle **127** for illustrative purposes. However, additive nozzle **137** can be positioned at other locations of nozzle support structure **124**. Additive nozzle **137** is connected to additive storage system **134** through an additive plumbing system **138** (FIG. **3***a*). Plumbing system **138** allows additives to flow between additive storage system **134** and colorant nozzle **137**. Plumbing system **138** includes four additive hoses, denoted as hoses **138***a*, **138***b*, **138***c* and **138***d* (FIG. **3***d*), which extend through nozzle **137** and terminate at nozzle openings **139***a*, **139***b*, **139***c* and **139***d*, respectively, as shown in FIG. **3***b*. It should be noted that the number of hoses in plumbing system **138** typically corresponds to the number of additives included in additive storage system **134**. The additives are dispensed through openings **139***a*-**139***f* and into paint container **110** wherein they are combined with the paint. As will be discussed in more detail with FIGS. **4***b* and **4***d*, the flow of additives through plumbing system **138** is controlled by computer system **101**. In particular, the additives are flowed through plumbing system **128** in response to the paint additive indication being provided to computer system **101**. In this way, computer system **101** is operatively coupled to dispenser **106** through an additive storage system.

FIGS. **4***a* and **4***b* are perspective views of one embodiment of colorant storage system **104** and additive storage system **134**, respectively, in accordance with the invention. Further, FIGS. **4***c* and **4***d* are schematic diagrams of colorant storage system **104** and additive storage system **134**, respectively. It should be noted that colorant storage system **104** and additive storage system **134** are typically housed by paint manufacturing system **100** in a colorant storage cabinet **109**, as shown in FIG. **2***b*, although they can be housed elsewhere.

In this embodiment, colorant storage system **104** is connected to plumbing system **128** through a colorant mass flow control system **112**. Colorant storage system **104** includes colorant storage containers **104***a*, **104***b*, **104***c*, **104***d*, **104***e* and **104***f* and mass flow control system **112** includes colorant mass flow controllers **112***a*, **112***b*, **112***c*, **112***d*, **112***e* and **112***f*. Colorant storage containers **104***a*, **104***b*, **104***c*, **104***d*, **104***e* and **104***f* are connected to colorant hoses **128***a*, **128***b*, **128***c*, **128***d*, **128***e* and **128***f*, respectively, through mass flow controllers **112***a*, **112***b*, **112***c*, **112***d*, **112***e* and **112***f*, respectively.

Computer system **101** controls the operation of colorant mass flow controllers **112***a*-**112***f* to control the amount of colorants which are allowed to flow through corresponding colorant hoses **128***a*-**128***f*. The operation of mass flow controllers **112***a*-**112***f* can be controlled by computer system **101**

in many different ways, such as by providing the paint color indication to system **101** through monitor **101***a* and/or input device **101***b*. In accordance with the invention, however, the operation of colorant mass flow controllers **112***a*-**112***f* is controlled by computer system **101** in response to the paint color indication being received by computer system **101** through computer network **113** and communication link **114**. In this way, computer system **101** is operatively coupled to dispenser **106** through a colorant storage system, and colorants are dispensed by dispenser **106** in response to a paint color indication.

Colorant containers **104***a*-**104***f* each contain a type of colorant which can be flowed into paint container **110** through colorant hoses **128***a*-**128***f* and corresponding openings **129***a*-**129***f* (FIG. **3***b*), as discussed above, wherein they are combined with the paint components contained in container **110**. In this way, the color of the paint components contained in container **110** is driven to the desired color.

It should be noted that, in this embodiment, colorant storage system **104** is shown as including six colorant containers for illustrative purposes, so it can provide six colors, as well as their corresponding color combinations. A color combination is two or more colors combined together to provide a shade of color. The two or more colors can be combined together in many different ways, such as by mixing. In other embodiments, however, colorant storage system **104** includes fewer or more colorants. For example, in one particular embodiment, colorant storage system **104** includes twelve colorant containers, so it can provide twelve colors, as well as their corresponding color combinations. In general, the number of colorant containers included in colorant storage system **104** determines the number of different colors and shades of colors that can be provided. The number of different colors and shades of colors that can be provided increases with the number of colorant containers. Further, the number of different colors and shades of colors that can be provided decreases with the number of colorant containers. The amount and colors of colorants flowed into paint container **110** can be determined in many different ways, a few of which will be discussed in more detail below.

In this embodiment, additive storage system **134** is connected to additive plumbing system **138** through an additive mass flow control system **132**. Additive storage system **104** includes additive storage containers **134***a*, **134***b*, **134***c* and **134***d* and mass flow control system **132** includes additive mass flow controllers **132***a*, **132***b*, **132***c* and **132***d*. Additive storage containers **134***a*, **134***b*, **134***c* and **134***d* are connected to hoses **138***a*, **138***b*, **138***c* and **138***d*, respectively, through mass flow controllers **132***a*, **132***b*, **132***c* and **132***d*, respectively.

Further, computer system **101** controls the operation of mass flow controllers **132***a*-**132***d* to control the amount of additives which are allowed to flow through corresponding hoses **138***a*-**138***d*. The operation of mass flow controllers **132***a*-**132***d* can be controlled by computer system **101** in many different ways, such as by providing the paint additive indication to system **101** through monitor **101***a* and/or input device **101***b*. In accordance with the invention, however, the operation of mass flow controllers **132***a*-**132***d* is controlled by computer system **101** in response to the paint additive indication being received by computer system **101** through computer network **113** and communication link **114**. In this way, computer system **101** is operatively coupled to dispenser **106** through an additive storage system and additives are dispensed by dispenser **106** in response to a paint additive indication.

Additive containers **134***a*-**134***d* each contain a type of additive which can be flowed into paint container **110** through hoses **138***a*-**138***d* and corresponding openings **139***a*-**139***d* (FIG. **3***b*), as discussed above, wherein they are combined with the paint components contained in container **110**. The additive(s) can be combined with the paint components in many different ways, such as by mixing.

It should be noted that, in this embodiment, additive storage system **134** is shown as including four additive containers for illustrative purposes, so it can provide four types of additives, as well as combinations thereof. In other embodiments, however, additive storage system **134** can include fewer or more additive containers. For example, in one particular embodiment, additive storage system **134** includes six additive containers, so it can provide six additives, as well as combinations thereof. In general, the number of additive containers included in additive storage system **134** determines the number of different additives and combinations of additives that can be provided. The number of different additives that can be provided increases with the number of additive containers. Further, the number of different additives that can be provided decreases with the number of additive containers. The type and amount of additives flowed into paint container **110** can be determined in many different ways, a few of which will be discussed in more detail presently.

In operation, computer system **101** has access to a paint data file, which generally includes paint color and paint type information. In this embodiment, the paint color and paint type information are included in the same data file. However, the paint color and paint type information can be included with a paint color data file and a paint type data file, respectively, so that the paint data file includes separate data files. Further, computer system **101** has access to a paint additive date file which corresponds to a desired type of additive to be added to the paint components. The additive data file can be included with the paint data file which includes the paint color and/or paint type information, or the additive data file can be a separate data file.

The paint color and paint type information can be read and changed, if desired, by computer system **101**. In some situations, the paint color and paint type information can be changed in response to a signal received by computer system **101** through monitor **101***a* and/or input device **101***b*. However, in accordance with the invention, the paint color and paint type information can be changed in response to a signal received by computer system **101** through computer network **113** and communication link **114**. In one particular embodiment, the paint color and/or paint type information are changed in response to a signal received by computer system **101** through internet server **113***b* and communication link **114**.

The paint data file can be an existing data file, or it can be created or changed in response to the paint type, paint color and/or paint additive indications provided to computer system **101**. The changes to the paint data file can be made by sending one or more signals to computer system **101** through computer network **113** and communication link **114**. Further, the paint color, paint type and/or paint additive data files can be existing data files, or they can be created or changed in response to the paint color, paint type and paint additive indications, respectively. The paint data file, color data file, paint type data file and/or paint additive data file can be stored internally with computer system **101** or externally to it, such as with internet server **113***b*.

In some embodiments, the paint color, paint type and/or paint additive indications are stored by the consumer on internet server **113***b*. In these embodiments, the consumer can

create a user account on internet server **113***b* and store information corresponding to the paint color, paint type and paint additive indications for later use. This is useful when the consumer desires to purchase paint corresponding to the same type and color of paint they previously purchased, wherein the paint includes the same type and amount of additive.

The color data file includes paint color information which corresponds to the desired color of the paint manufactured with paint manufacturing system **100**. The paint color information often represents the desired color in terms of a particular color scale. There are many different color scales that can be used to represent the desired color, with one being the Hunter color scale. The Hunter color scale represents colors with three color values, denoted as L, a and b. Hence, the paint color information can include L, a and b values corresponding to the desired color.

The paint type data file includes paint type information which corresponds to the desired type of the paint manufactured with paint manufacturing system **100**. It should be noted that the desired type of paint includes a base paint, and the base paint typically depends on the desired color of paint. This is because the colorants are combined with the base paint to provide the paint with a desired shade of color. For example, if a dark color is desired, the paint type indication generally corresponds to a neutral base paint. If a light color is desired, the paint type indication generally corresponds to a pastel base paint. Colorants are combined with the base paint to provide a shade of color between pastel and neutral. Hence, the paint color indication depends on the paint type indication and the color data file depends on the paint type data file.

As mentioned above, the paint type, paint color and paint additive indications can be provided to computer system **101** in many different ways. In accordance with the invention, the paint type, paint color and paint additive indications are provided to computer system **101** by computer network **113** through communication link **114**. In other situations, the paint type, paint color and paint additive indications are provided to computer system **101** by providing corresponding input through monitor **101***a* and/or input device **101***b*. The paint type, paint color and paint additive indications are generally provided to computer system **101** in response to an indication that a consumer desires a particular type and color of paint, which includes the desired additive. The paint type, paint color and paint additive data files are selected in response to the paint type, paint color and paint additive indications, respectively, provided to computer system **101**.

In one situation, the paint type and paint color indications are provided to computer system **101** in response to one or more inputs provided to computer system **101** through computer network **113** and communication link **114**. A paint type data file is selected in response to the paint type indication. The selected paint type data file corresponds to a base paint having a color associated with the color indicated by the paint color indication. A color data file is selected in response to the desired paint color indication. The selected color data file corresponds to the type and amount of colorants that will drive the color of the base paint, when combined therewith, to the desired color. In this way, the desired type of paint having the desired color is manufactured, by using a paint manufacturing system, in response to a remote indication that a consumer wants a desired paint.

If desired, the additive can be added to the base paint, as described in more detail above. For example, the additive can be added to the base paint by providing the paint additive indication to computer system **101** through computer network **113** and communication link **114**. Further, the additive can be added to the base paint by providing the paint additive indication to computer system **101** through monitor **101***a* and/or input device **101***b*.

In another situation, the paint type and paint color indications are provided to computer system **101** in response to one or more inputs provided to computer system **101** through monitor **101***a* and/or input device **101***b*. A paint type data file is selected in response to the paint type indication. The selected paint type data file corresponds to a base paint having a color associated with the color indicated by the paint color indication. In response to the desired paint color indication, a color data file is selected. The selected color data file corresponds to the type and amount of colorants that will drive the color of the base paint, when combined therewith, to the desired color. In this way, the desired type of paint having the desired color is manufactured, by using paint manufacturing system **100**, in response to an indication that a consumer wants a desired paint. In other situations, however, the paint color indication is provided to computer system **101** with a colorant signal, as will be discussed in more detail below. If desired, the additive can be added to the base paint by providing the paint additive indication to computer system **101** through monitor **101***a* and/or input device **101***b*.

In one situation, the paint type, paint color, and paint additive indications are provided to computer system **101** in response to one or more inputs provided to computer system **101** through monitor **101***a* and/or input device **101***b*. A paint type data file is selected in response to the paint type indication. The selected paint type data file corresponds to a base paint having a color associated with the color indicated by the paint color indication. In response to the desired paint color indication, a color data file is selected. The selected color data file corresponds to the type and amount of colorants that will drive the color of the base paint, when combined therewith, to the desired color. Further, a paint additive data file is selected in response to the paint additive indication. The selected paint additive indication corresponds to the desired type and amount of additive to be added to the paint components. In this way, the desired type of paint having the desired color and additive is manufactured, by using paint manufacturing system **100**, in response to an indication that a consumer wants a desired paint. In other situations, however, the paint color indication is provided to computer system **101** with a colorant signal, as will be discussed in more detail presently.

As shown in FIG. **2***b*, paint manufacturing system **100** includes a spectrophotometer **102** in communication with computer system **101**. Spectrophotometer **102** can be in communication with computer system **101** in many different ways, but a cable **103** is used here. In this way, computer system **101** and spectrophotometer **102** are operatively coupled together so signals can flow between them. Spectrophotometer **102** can be of many different types, such as those available from Greta Macbeth, MatchRite and Datacolor. Examples of spectrophotometers are also disclosed in U.S. Pat. Nos. 6,002,488 and 6,198,536.

Spectrophotometer **102** includes a sample holder **119** for holding a color sample **122**. Color sample **122** can be of many different types, but it is often a color card corresponding to the desired color. In this way, the color of color sample **122** corresponds to the desired color of paint to be manufactured using paint manufacturing system **100**.

In operation, spectrophotometer **102** flows a colorant signal $S_{Colorant}$ to computer system **101** through cable **103**, wherein colorant signal $S_{Colorant}$ corresponds to the reflectance of color sample **122**. The reflectance of color sample **122** corresponds to its paint color information. In response to colorant signal $S_{Colorant}$, computer system **101** stores the

paint color information. The paint color information can be stored in many different locations, such as with the paint data file or an existing or created color data file. In this way, computer system **101** has access to paint color information corresponding to the color of color sample **122**.

Once computer system **101** has access to the desired paint type and color information, computer system **101** determines the paint components and colorants needed to drive the color of the paint components to match the desired color. In this way, computer system **101** determines the paint components and colorants needed to drive the color of the base paint to match the desired color. It should be noted that, in accordance with the invention, the paint components and colorants are determined before they are dispensed. However, in some embodiments, the paint components and colorants can be determined after one or more of them are dispensed. For example, the paint components can be dispensed before the colorants are determined. It should be noted that it is generally desirable to decrease the amount of time between when the paint components and colorants are dispensed to preserve the quality of the paint.

After the paint type and colorants have been determined, computer system **101** provides an indication to mass flow control system **131** so that paint component storage system **130** dispenses the selected paint components. More information regarding the mass flow control system and paint component storage system is provided with FIGS. **2***a* and **2***c*. The selected paint components are dispensed by dispenser **106** to form the base paint, which is contained by container **110**. Computer system **101** also provides an indication to mass flow control system **112** so that colorant storage system **104** dispenses the selected colorants. The selected colorants are dispensed by dispenser **106** into container **110** to drive the color of the base paint to match the desired color. If the color indication is provided by selecting the color data file, the color is driven to match the color corresponding to the paint color information included therein. If the color indication is provided by signal $S_{Colorant}$, the color is driven to match the color of color sample **122**. In this way, the paint color indication can be provided to computer system **101** by using a spectrophotometer and a color sample.

It should be noted that the colorants can be selected in many different ways. For example, they can be selected to provide a desired accuracy in matching the color of the paint to the color of color sample **122**. The colorants can also be selected based on cost. This is useful because some colorants are more expensive than others. Hence, the colorants can be selected to reduce costs, as well as the accuracy in color matching. The colorants can also be chosen in response to a desired use. For example, some colorants are better suited for outdoor use and other colorants are better suited for indoor use.

The program operated by computer system **101** determines the type of paint components, as well as their amounts, necessary to make the desired type of paint. In response to the determination of the type of paint components, computer system **101** operates flow control system **131** so that paint component storage system **130** flows the amount and type of paint components to dispenser **106** through plumbing system **115**. The paint components are dispensed by nozzles **118** into paint container **110**, as described above, to form desired paint **121**. In this way, nozzles **118** dispense pre-selected paint components in response to an indication from computer system **101**. The amount of paint components dispensed can be determined in many different ways, such as by volume and weight. In this embodiment, however, the paint components are dispensed by weight, as determined by paint weight scale **111**.

The program operated by computer system **101** also determines a cleaning amount of the dispersant-thickening agent component to make the desired type of paint and subtracts the cleaning amount from the total amount of dispersant thickening agent for making the desired type of paint to equal the dispensing amount of dispersant thickening agent. Generally, the cleaning amount of the dispersant-thickening agent is in the range of about 0.25% by weight to about 25% by weight of the total amount of dispersant-thickening agent. For example, the cleaning amount of the dispersant thickening agent component may be about 30 ml. total. With six paint component containers **130***a*, **130***b*, **130***c*, **130***d*, **130***e* and **130***f*, the cleaning amount per cleaning squirt nozzle **99***a*, **99***b*, **99***c*, **99***d*, **99***e* and **99***f* may be about 5 ml.

Nozzles **118** dispense pre-selected amounts of paint components to make the desired paint followed by nozzles **99** which dispense the cleaning amount of dispersant thickening agent.

The pre-selected paint components flow through nozzles **118** followed by the cleaning amount of the dispersant-thickening agent through nozzles **99** removing residue from the production of the immediate aqueous paint composition before the next aqueous paint composition is produced at the point of sale.

As discussed above, desired paint **121** can be provided with a desired color by using color sample **122** and spectrophotometer **102** or by using a color data file. In the situation in which color sample **122** and spectrophotometer **102** are used, color sample **122** is held by sample holder **119** and spectrophotometer **102** flows colorant signal $S_{Colorant}$ to computer system **101** through cable **103**. Computer system **101** receives signal $S_{Colorant}$ and determines the amount and color of the colorants needed to drive the color of the paint component combination contained by container **110** to match the color of color sample **122**. The amount of paint colorants dispensed can be determined in many different ways, such as by volume and weight. In this embodiment, however, the colorants are dispensed by volume, as determined by colorant mass flow control system **112**.

In response to the determination of the colorants, computer system **101** operates colorant mass flow control system **112** so that colorant storage system **104** flows the amount and color of colorants to dispenser **106** through plumbing system **128**. The colorants are dispensed by colorant nozzle **127** into paint container **110** so that desired paint **121** is provided with a desired color. In this way, plumbing system **128** allows colorant components to flow between colorant storage system **104** and colorant nozzle **127** in response to an indication from computer system **101**.

In the situation in which the color data file is used, the color data file is selected and it provides data to computer system **101** that corresponds to the desired color. The color data file can be selected using an input device such as monitor **101***a* and/of keyboard 10 lb. However, in accordance with the invention, the color data file can be selected using computer network **113**. Colorant storage system **104** dispenses the colorants so, when combined with the paint components, the combination has a color driven to match the color represented by the color data file. Hence, the paint color indication can be provided to computer system **101** by selecting the color data file that corresponds with the desired color.

If desired, one or more additives can be added to the paint components, as discussed in more detail above. For example, in response to the paint additive indication, computer system

101 operates additive mass flow control system 132 so that additive storage system 134 flows the type and amount of additive(s) to dispenser 106 through additive plumbing system 138. The additive(s) are dispensed by additive nozzle 137 into paint container 110 so that desired paint 121 is provided with the desired additive(s). In this way, additive plumbing system 138 allows one or more additives to flow between additive storage system 134 and additive nozzle 137 in response to an indication from computer system 101.

In the situation in which the additive data file is used, the additive data file is selected and it provides data to computer system 101 which corresponds to the desired type and amount of additive(s) to be added to desired paint 121. The additive data file can be selected using an input device such as monitor 101*a* and/of keyboard 10 lb. However, in accordance with the invention, the additive data file can be selected using computer network 113. Additive storage system 134 dispenses the additive(s) so they are added to the paint components and combined therewith. Hence, the paint additive indication can be provided to computer system 101 by selecting the additive data file that corresponds with the desired type and amount of additive(s).

FIG. 5*a* is a block diagram of a method 150, in accordance with the invention, of manufacturing paint. In this embodiment, method 150 includes a step 151 of providing at least two paint components in response to an indication from a computer network, and a step 152 of manufacturing a paint by combining the paint components at a point of sale. In accordance with the invention, the paint components are provided by a paint manufacturing system. Further, the paint components are contained in separate paint component containers before they are combined. The paint components can be combined in many different ways, such as by mixing. In accordance with the invention, the paint components are selected from a group that includes a pigment composition, a dispersant thickening agent, and a resin content binder. It should be noted that the resin content binder can be a material with a high or low resin content, wherein the high resin content material includes more resin than the low resin content material. In one particular embodiment, the paint components include a resin content binder, and a pigment composition and/or dispersant thickening agent.

FIG. 5*b* is a block diagram of a method 155, in accordance with the invention, of manufacturing a desired type of paint. In this embodiment, method 155 includes a step 156 of providing a paint manufacturing system, which includes a computer system in communication with a computer network, and a dispenser operatively coupled to the computer system. It should be noted that the dispenser and computer system are typically located at the point of sale. Further, a portion of the computer network, such as an internet server, can be located at the point of sale.

Method 155 includes a step 157 of dispensing, through the dispenser, a predetermined combination of paint components in response to a paint type indication being provided to the computer system through the computer network. The desired paint is formed in response to the paint components being dispensed. The dispenser dispenses at least two paint components in response to the paint type indication. It should be noted that the paint components are dispensed at the point of sale.

FIG. 5*c* is a block diagram of a method 160, in accordance with the invention, of manufacturing a desired type of paint. In this embodiment, method 160 includes a step 161 of providing a paint manufacturing system, which includes a computer system in communication with a computer network, and a dispenser and paint component storage system operatively coupled to the computer system. It should be noted that the computer system, dispenser and paint component storage system are typically located at the point of sale. Method 160 includes a step 162 of flowing, from the paint component storage system, a predetermined combination of paint components in response to a paint type indication being provided to the computer system through the computer network. Method 160 includes a step 163 of dispensing the predetermined combination of paint components through the dispenser. Method 160 includes a step 164 of dispensing the cleaning amount of dispersant-thickening agent through the dispenser. The desired paint is formed in response to the paint components being dispensed. The dispenser dispenses at least two paint components in response to the paint type indication.

FIG. 5*d* is a block diagram of a method 165, in accordance with the invention, of manufacturing paint. In this embodiment, method 165 includes a step 166 of providing a paint manufacturing system which includes a computer system and computer network in communication with each other, and a dispenser. Method 165 includes a step 167 of providing a paint type indication to the computer system through the computer network. Method 165 includes a step 168 of dispensing a predetermined combination of paint components in response to the paint type indication being provided to the computer system through the computer network. The desired paint is formed at the point of sale in response to the paint components being dispensed.

In some embodiments, the paint manufacturing system of method 165 includes a colorant storage system operatively coupled to the computer system, wherein the colorant storage system is in fluid communication with the dispenser. In these embodiments, method 165 can include flowing a predetermined combination of colorants from the colorant storage system to the dispenser in response to a paint color indication. The paint color indication is provided to the computer system through the computer network. The colorants are dispensed by the dispenser and combined with the paint components.

In some embodiments, the paint manufacturing system of method 165 includes an additive storage system operatively coupled to the computer system, wherein the additive storage system is in fluid communication with the dispenser. In these embodiments, method 165 can include flowing a predetermined additive from the additive storage system to the dispenser in response to a paint additive indication. The paint additive indication is provided to the computer system through the computer network. The predetermined additive is dispensed by the dispenser and combined with the paint components.

FIG. 5*e* is a block diagram of a method 170, in accordance with the invention, of manufacturing a desired type and color of paint. In this embodiment, method 170 includes a step 171 of providing a paint manufacturing system, which includes a computer system in communication with a computer network, and a dispenser and paint component and colorant storage systems operatively coupled to the computer system. It should be noted that the computer system, dispenser and paint component and colorant storage systems are typically located at the point of sale. Further, a portion of the computer network, such as an internet server, can be located at the point of sale.

Method 170 includes a step 172 of flowing, from the paint component storage system, a predetermined combination of paint components in response to a paint type indication being provided to the computer system through the computer network. Method 170 includes a step 173 of dispensing the predetermined combination of paint components through the dispenser. The desired paint is formed in response to the paint

components being dispensed. The dispenser dispenses at least two paint components in response to the paint type indication. Method **170** includes a step **174** of flowing, from the colorant storage system, a predetermined combination of colorants in response to a paint color indication provided to the computer system through the computer network. Method **170** includes a step **175** of dispensing the predetermined combination of colorants through the dispenser. The colorants are combined with the paint components. The combination of colorants drives the color of the paint components to match the desired color.

In some embodiments, the paint manufacturing system of method **170** includes an additive storage system operatively coupled to the computer system, wherein the additive storage system is in fluid communication with the dispenser. In these embodiments, method **170** can include flowing a predetermined combination of additive(s) from the additive storage system to the dispenser in response to a paint additive indication. The paint additive indication is provided to the computer system through the computer network. The additive(s) are dispensed by the dispenser and combined with the paint components. It should be noted that the predetermined combination of additive(s) can be one or more additives.

FIG. **6***a* is a block diagram of a method **180**, in accordance with the invention, of ordering paint. In this embodiment, method **180** includes a step **181** of using a computer network to select a desired type of paint. The desired type of paint is generally selected using a web browser. Method **180** includes a step **182** of providing a paint type indication, which corresponds with the desired type of paint, to a computer system included in a paint manufacturing system. The paint type indication is provided by the computer network to the computer system through a communication link.

Method **180** includes a step **183** of dispensing, with the paint manufacturing system, at least two paint components to form the desired type of paint. The paint components are dispensed at the point of sale. The paint components are combined together, such as by mixing, at the point of sale. In accordance with the invention, the paint components are selected from a group that includes a pigment composition, a dispersant thickening agent, and a resin content binder. In one particular embodiment, the paint components include a resin content binder, and a pigment composition and/or dispersant thickening agent. In accordance with the invention, the paint components are contained in separate containers before they are combined together.

It should be noted that method **180** can include many other steps. For example, in some embodiments, method **180** includes a step of paying for the paint using the computer network. It should be noted, however, that the paint can be paid for at the point of sale, and in many other ways. Method **180** can also include a step of shipping the paint, such as to his or her house or business. It should be noted, however, that the paint can be picked-up at the point of sale. For example, the consumer can go to the point of sale and retrieve the paint.

FIG. **6***b* is a block diagram of a method **185**, in accordance with the invention, of ordering a desired type of paint. In this embodiment, method **185** includes a step **186** of using a computer network to select the desired type of paint. Method **185** includes a step **187** of providing a paint type indication, which corresponds with the desired type of paint, to a computer system included in a paint manufacturing system. In one embodiment, the paint type indication is provided to the computer system through the computer network. The paint manufacturing system also includes a dispenser operatively coupled to the computer system. It should be noted that the dispenser and computer system are typically located at the point of sale.

Method **185** includes a step **188** of dispensing, with the dispenser, a predetermined combination of paint components in response to the paint type indication being provided to the computer system through the computer network. The desired paint is formed in response to the paint components being dispensed. The dispenser dispenses at least two paint components in response to the paint type indication. It should be noted that the paint components are typically dispensed at the point of sale.

FIG. **6***c* is a block diagram of a method **190**, in accordance with the invention, of ordering a desired type of paint. In this embodiment, method **190** includes a step **191** of using a computer network to select the desired type of paint. Method **190** includes a step **192** of providing a paint type indication, which corresponds with the desired type of paint, to a computer system included in a paint manufacturing system. The computer system is typically in communication with the computer network through a communication link. The paint manufacturing system also includes a dispenser and paint component storage system operatively coupled to the computer system. It should be noted that the computer system, dispenser and paint component storage system are typically located at the point of sale.

Method **190** includes a step **193** of flowing, from the paint component storage system, a predetermined combination of paint components in response to a paint type indication being provided to the computer system through the computer network. Method **190** includes a step **194** of dispensing the predetermined combination of paint components through the dispenser, wherein the paint components are dispensed at the point of sale.

FIG. **6***d* is a block diagram of a method **195**, in accordance with the invention, of ordering paint. In this embodiment, method **195** includes a step **196** of using a computer network to select the desired type of paint. Method **195** includes a step **197** of providing a paint type indication, which corresponds with the desired type of paint, to a computer system included in a paint manufacturing system. In this embodiment, the paint manufacturing system also includes a dispenser and a computer network in communication with the computer system. Method **195** includes a step **198** of dispensing a predetermined combination of paint components in response to the paint type indication being provided to the computer system through the computer network. The desired paint is formed in response to the paint components being dispensed.

In some embodiments, the paint manufacturing system of method **195** includes a colorant storage system operatively coupled to the computer system, wherein the colorant storage system is in fluid communication with the dispenser. In these embodiments, method **195** can include using the computer network to select a desired color of paint and a step of flowing a paint color indication to the computer system. In response to the paint color indication, a predetermined combination of colorants from the colorant storage system are flowed to the dispenser. The colorants are dispensed by the dispenser and combined with the paint components.

In some embodiments, the paint manufacturing system of method **195** includes an additive storage system operatively coupled to the computer system, wherein the additive storage system is in fluid communication with the dispenser. In these embodiments, method **195** can include flowing a predetermined additive from the additive storage system to the dispenser in response to a paint additive indication. The paint additive indication is provided to the computer system

through the computer network. The predetermined additive is dispensed by the dispenser and combined with the paint components.

FIG. **6***e* is a block diagram of a method **200**, in accordance with the invention, of ordering a desired type and color of paint. In this embodiment, method **200** includes a step **201** of using a computer network to select the desired type and color of paint. Method **200** includes a step **202** of providing a paint type indication and paint color indication to a computer system included in a paint manufacturing system. In accordance with the invention, the paint type and color indications are provided to the computer system through the computer network. The paint type indication corresponds with the desired type of paint and the paint color indication corresponds with the desired color of paint.

In this embodiment, the paint manufacturing system also includes a dispenser in fluid communication with the paint component and colorant storage systems. Further, the paint component and colorant storage systems are operatively coupled to the computer system. It should be noted that the computer system, dispenser and paint component and colorant storage systems are typically located at the point of sale. Further, a portion of the computer network, such as an internet server, can be located at the point of sale.

Method **200** includes a step **203** of dispensing a predetermined combination of paint components in response to the paint type indication being provided to the computer system through the computer network. The desired paint is formed in response to the paint components being dispensed. In step **203**, the paint components are flowed from the paint component storage system to the dispenser in response to the paint type indication being provided to the computer system through the computer network.

Method **200** includes a step **204** of dispensing a predetermined combination of colorants in response to the paint color indication being provided to the computer system through the computer network. The colorants drive the color of the paint components to match the desired color. The colorants drive the color of the paint components to match the desired color when the colorants are combined with the paint components. In step **204**, the colorants are flowed from the colorant storage system to the dispenser in response to the paint color indication being provided to the computer system through the computer network.

In some embodiments, the paint manufacturing system of method **200** includes an additive storage system operatively coupled to the computer system, wherein the additive storage system is in fluid communication with the dispenser. In these embodiments, method **200** can include flowing a predetermined combination of additive(s) from the additive storage system to the dispenser in response to a paint additive indication. The paint additive indication is provided to the computer system through the computer network. The additive(s) are dispensed by the dispenser and combined with the paint components. It should be noted that the predetermined combination of additive(s) can be one or more additives.

It should be noted that the steps in the methods discussed in FIGS. **5***a*-**5***e* and **6***a*-**6***e* can be carried out in many different orders other than the ones described here. Further, the steps in the different methods can be combined together in many ways. It should also be noted that, in any of the embodiments of the methods discussed in FIGS. **5***a*-**5***e* and **6***a*-**6***e*, the paint type and color indications can be provided to the computer system through an input device, such as a keyboard or touch-screen display. However, in accordance with the invention, the paint type and color indications are provided to the computer system through the computer network. In this way, the paint type and color indications are provided remotely.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

The invention claimed is:

1. A method for producing an aqueous paint composition comprising:

selecting a paint composition recipe through a user interface, wherein the paint composition recipe comprises a stable premixed aqueous dispersant-thickening agent composition;

computationally determining a cleaning amount of the dispersant-thickening agent composition and subtracting the cleaning amount of the dispersant-thickening agent composition from a total amount of the dispersant-thickening agent composition to equal a dispensing amount of the dispersant-thickening composition;

dispensing the dispensing amount of the dispersant-thickening agent composition with the paint composition recipe to a receiving reservoir; and then dispensing the cleaning amount of the dispersant-thickening agent composition to the receiving reservoir and agitating the receiving reservoir to produce the aqueous paint composition.

2. The method of claim **1**, wherein the paint composition recipe further comprises at least two different stable premixed aqueous compositions selected from the group consisting of a stable pigment composition, a stable high resin composition, and/or a stable low resin composition.

3. The method of claim **1**, wherein the cleaning amount is equal to or greater than the total amount of the dispersant-thickening agent composition and the dispensing amount of dispersant-thickening-agent composition is zero.

4. The method of claim **1**, wherein the cleaning amount of the dispersant-thickening agent composition is dispensed following the dispensing of the dispensing amount of the dispersant-thickening agent composition with the paint composition recipe to a receiving reservoir.

5. The method of claim **1**, wherein the cleaning amount of the dispersant-thickening agent composition is in the range of about 0.25% by weight to about 25% by weight of the total amount of dispersant-thickening agent composition.

6. The method of claim **1**, wherein the cleaning amount of the dispersant thickening agent composition is about 30 ml.

7. The method of claim **1**, wherein the cleaning amount of the dispersant-thickening agent composition and the dispensing amount of the dispersant-thickening agent composition are dispensed through separate nozzles.

8. The method of claim **7**, wherein the cleaning amount of the dispersant-thickening agent composition is dispensed through a squirt nozzle.

9. The method of claim **8**, wherein a number of squirt nozzles is equal to how many of the at least two different stable premixed aqueous compositions and the stable premixed aqueous dispersant-thickening agent composition are in the paint composition recipe.

10. The method of claim **9**, wherein the cleaning amount of the dispersant-thickening agent composition is divided by the number of squirt nozzles dispensed equally through the number of squirt nozzles.

11. A paint manufacturing system comprising:

a point of sale having a computer system, wherein the computer system:

provides a user interface for selecting a paint composition recipe through the user interface, wherein the paint composition recipe comprises a stable premixed aqueous dispersant-thickening agent composition; and

operates a program to computationally determine a cleaning amount of the dispersant-thickening agent composition and subtracting the cleaning amount of the dispersant-thickening agent composition from a total amount of the dispersant-thickening agent composition to equal a dispensing amount of the dispersant-thickening composition; and

a dispenser, wherein the dispenser dispenses the dispensing amount of the dispersant-thickening agent composition with the paint composition recipe to a receiving reservoir; and then dispenses the cleaning amount of the dispersant-thickening agent composition to the receiving reservoir and agitating the receiving reservoir to produce the aqueous paint composition.

12. The system of claim **11**, further comprising a paint storage system, wherein the dispenser dispenses the composition recipe from the paint storage system to the receiving reservoir.

13. The system of claim **11**, wherein the paint composition recipe further comprises at least two different stable premixed aqueous compositions selected from the group consisting of a stable pigment composition, a stable high resin composition, and/or a stable low resin composition.

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